JPRS-UAC-89-012
31 OCTOBER 1989

FOREIGN BROADCAST INFORMATION SERVICE

JPRS Report

Soviet Union

AVIATION & COSMONAUTICS

No 6, June 1989

Soviet Union
AVIATION AND COSMONAUTICS
No 6, June 1989

JPRS-UAC-89-012 CONTENTS *31 October 1989*

[The following are translations of selected articles from the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated]

AVIATION AND COSMONAUTICS

No 6, June 1989

Gaining Combat Flying Proficiency Versus Flight Safety

91441332a Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 1-3

[Article by Col Gen Avn P. Belonozhko, first deputy chief of the Main Staff of the Air Force: "Combat Readiness, Skill, Flight Safety]

[Text] Figuratively speaking, June is the equator of combat training. Half the journey to the heights of military skill specified by the year's plan has been covered. There have been achievements, and there have been miscues. This attests to the fact that the tight knot of problems existing in the Air Force is not so easily untied. One of the most important problems facing headquarters staffs of units and subunits in particular is the following: how can a high level of pilot proficiency be achieved without detriment to flight safety? The following example shows how critical it is.

In the course of a tactical air exercise the squadron with which Maj L. Dementyev serves as executive officer was assigned the mission of destroying an important installation behind "enemy" lines. Wanting to accomplish the mission as well as possible, the squadron commander led a strike element in at low level, although not all his men were actually ready to fly such a mission configuration. As a result it was by pure miracle that the element leader did not "lose" his wingmen among the roundtop hills. But when upbraided by the inspecting officer, he stated that he had been acting in the interests of combat readiness and without unnecessary situation simplification.

Here is an incident of a different kind. At a squadron exercise subunit executive officer Maj I. Nikolayenko emasculated the exercise of tactical elements to such a degree that 83 percent of the aircraft in a strike force which had departed on a mission were designated as destroyed by air defense assets on the approaches to the target. In justification of his actions the officer stated that he had been guided primarily by the interests of flight safety.

Who is right? At first glance it would seem that both are right to a certain degree. In actual fact, however, neither of them are right, since both of them went to extremes, as they say. In these incidents the staff officers were also at fault.

Yes, there has long been debate on adding degree of complexity to combat training and on level of flight safety, with flight operations allegedly directly dependent on the degree of complexity offered. It would seem high time to obtain full clarity in this matter, but the debate continues to rage on. Even experienced executive officers are unable to give a distinct response to these problems. This is probably because the essence of Air Force activities appears too simple in some quarters: combat readiness - skill - flight safety.

In actual fact things are not that simple. One must be clearly aware of the fact that the main thing in tactical training is not the number of tactical air exercises but their quality. This is demanded by our defense doctrine and by intelligent utilization of our resources. Each and every ruble spent by our people on defense should produce maximum increase in combat skill on the part of the defenders of the homeland.

We shall endeavor to analyze the formula: combat readiness - skill - safety.... On the one hand these components are so interrelated that no dividing line can be placed between them. On the other hand these are qualitatively independent and unique phenomena. Each has its own content, its own methods, its own "technology." Unfortunately in this regard headquarters staffs many times fail to perform the role of skilled coordinating center.

There is also another facet to consider here. In a certain sense these fundamental, basic elements of Air Force vital activities are in a conflictive relationship with one another. Apparently this is another reason why the debate rages on over which of these components sets the "tone" in military aviation and which one only affects its development in one way or another. We can state one thing here: to claim full and complete resolution of the problem means not only moving from the domain of the possible into the realm of the desired, but also means testifying to one's lack of understanding of the objective dynamics of Air Force affairs.

Let us assume that an Air Force unit has been operating aircraft of a specific type for a period of five years. What should be considered determining in the work of the commanding officer, his staff, the political agency, and the men of this unit? Unquestionably it is continuously increasing combat readiness. The foundation for this, in the form of amassed professional skill, is entirely appropriate. This in turn also presupposes a high level of securement of flight safety. Hence the unique directional thrust of the work of all duty assignment structures in this unit. In view of the fact, however, that some people still prefer a cavalier-attitude interpretation of any thesis, I should note that improvement of combat readiness gives no reason to forget that skill can be lost and that flight safety will diminish in parallel with this process. Consequently it is the duty of staff officers to organize and conduct specialized preventive measures in such a manner as to build upon amassed experience and know-how.

But what if a unit is just beginning to master a new aircraft? Is it correct and wise to use the same measuring sticks in approaching matters pertaining to ensuring full-value combat readiness and flying proficiency even if all the pilots in the regiment are 1st class, for example? The answer is obvious. At the initial stage of training on

new aircraft quality of mastering the equipment and flight safety are the primary elements.

In short, only the regimental authorities and the military collective itself can correctly distribute the priorities among vitally important tasks. It is not somebody at a higher echelon but rather the commanding officer, chief of staff, party organization, and personnel who know the true state of affairs in the unit, and not a distorted or embellished picture. Incidentally, practical experience continues to demonstrate the harmfulness of illusory achievements and deliberate supercautiousness. And both of them do harm and detriment to combat readiness, proficiency, and safety.

Here is another thing staff officers who plan and schedule the training process should not forget. Priorities cannot be set so that they are permanently unchanged, even for one and the same unit, subunit, and aircrew. Everything depends on the degree of newness and complexity of flight assignments, weather, and combat training period, that is, in the final analysis on a truthful reply to the question: what are the pilot, flight, squadron, and regiment actually prepared for today?

Some might say that the new is always new and the complex is always complex, and how can one not go beyond the boundary of flight safety when practicing unfamiliar maneuvers? I believe that for this one must have a dialectical understanding of newness and complexity of problems. What does a new flight assignment mean? It means first and foremost that to those elements which are performed repeatedly is added that which the crew (pilot) has never done before. But there may be two, or three, or five such elements.... This is where the wisdom and experience of the commander, staff, and pilot must be brought to bear. An entire series of additional elements can be added to the flight assignment for some, while only one or two additional elements should be added for another. Let the pilot, as they say, become organically "absorbed" into the unaccustomed.

The same can be said about increasing complexity. We are talking precisely about an increase, not a flood, under the psychological burden of which a military pilot may simply break. In my opinion the correct solution to a methodological problem is as follows: one must know the limits of the professional capabilities of a specific individual at a given moment and never go beyond them, while at the same time each individual should work at the limits of his capabilities, without applying an inadequate work load, which has a weakening effect. These are "particular coefficients" of the general formula. From a flight assignment for each pilot which is well-substantiated and validated in level of complexity, to individual psychological training drill. From objectivity of evaluation of a flight to the content of textbooks, manuals, and methods diagrams. From a developed sense of responsibility on the part of all categories of personnel to full-value rest. Obviously these coefficients are not at all simple. Their true magnitude lies in people's souls, thoughts, and ability....

Let us return, however, to the general formula and see in what the qualitative uniqueness of the specific elements of the continuously-operating combat aviation triad consists. We shall gain an understanding of the fact that it is necessary for analytical and methodological work in the area of increasing combat readiness, intensification of professional skill, and achievement of stable, continuing flight safety. This is a principle of theory. At the practical level there is of course no such division.

Combat readiness, proficiency, and safety are an integral whole. One does not exist and has no meaning without the other. This pertains to a mission-specific function, so to speak. But each component is fairly independent in its functioning. Their uniqueness and independence are manifested in many relationships. In the forms through which each component is realized. In the dynamics and sequence of concentration of efforts. In work intensification methods. In the consequences of incompetent decisions by commanders and staffs and in the incisiveness of their responsibility. In capabilities of objective assessment of the state and status of the components proper.

The special value of genuine competence on the part of aviation personnel of all job position statuses also proceeds from the qualitative uniqueness of the three components. And each individual has his own duties, his own place, his own role, and his own capabilities in the operation of the triad and in stable, continuing interaction of its components.

This is undisputed and would not seem to cause any confusion or any ambiguity. Unfortunately, however, it only seems so. We suffer an acute lack of competent approaches! The structure of job positions in combat aviation was created not in order to distribute ranks, titles and pay rates but in order to ensure that there is a knowledgeable, experienced, questing and responsible individual at every key point, an individual who performs duties in respect to that which is prescribed by a legal document, but not a mechanical "relay element" standing between echelons of command. To execute means first and foremost to reanalyze and reinterpret stated requirements as applied at one's own specific level, to translate directive material into essential working measures. And to prescribe means to arm subordinates with content-filled, substantial recommendations for their personal activities.

This is a very important element. It is no mere coincidence that military aviators so vigorously oppose the stream of redundant instructions which have flooded headquarters staffs, for one must respond to a mass of documents, and yet they contain a great many repetitions and duplications engendered by incompetence and excessive attention to form with consequent detriment to content. Inspections which we make in the units reveal downright masterpieces of paper-shuffling. Let us

assume that a subunit is readying for a tactical air exercise. The commanding officer receives appropriate instructions from combined unit headquarters. You read these instructions and see that they are a verbatim copy of a great many pages from the combat training course. There is not even a hint of tie-in to a specific subunit, area of operations, or type of aircraft. Who needs this? As a result subordinates study not a document grounded on specific factual material but only a rough "billet," while losing precious time to boot.

Should one be surprised that this is followed by a chain reaction of lip service? Totally unfocused instructions by the commanding officer, and also processed in a lip-service manner by the combined unit and unit staff.

Frequently there is also a similar attitude toward documents pertaining to flight safety. Packages of measures directed toward the entire Air Force are sent down from one echelon to the next, virtually without processing or even elementary correction and adjustment. And it turns out that these "blocks" settle to the bottom in the pilot's notebook and consciousness. For example, the task of commercially designing and building a new training simulator is assigned by the higher echelon. And the pilot in turn repeats that a new trainer must be developed, instead of working out, for example, a specific individual practice session plan and schedule for the cockpit or using models. In order to prevent this from happening, a great many people must alter their work style. Unfortunately it is much simpler to be redundant. Self-important resolutions appear on documents of abstract content: "For execution to the letter...," "For precise implementation..."

But where is common sense? Is the pilot able unswervingly to carry out an entire comprehensive program directed toward the entire Air Force? Many of these deficiencies are connected with miscues in training officers for higher positions. An officer was promoted to a higher position, for example. Another star was also added to his shoulder boards. But what does this mean in practical terms? For some officers it means almost nothing. Captain Petrov used to hold the position, and Major Petrov now holds it; that is the entire difference. And yet the position of squadron deputy commander, for example, is a very special step forward in the career of yesterday's flight commander....

Unfortunately not all perceive career advancement in this manner. Restriction of an officer's activities solely to reproducing that which he once saw, something he once heard somewhere, or intuitively, also begins with this. And this instead of reassessing one's new position in the unit and in operations from A to Z, to find one's place and one's responsibility, which is shared by nobody else.

The problem is that it is not only easier but sometimes more reliable as well to reproduce and "relay" to headquarters staffs. "I did everything stated in the document," some executive officer or chief of staff will state confidently, throwing the inspecting officer into embarrassed perplexity. Did it never occur to the inspecting officer that there was nothing stated in the document for a commander or executive officer of the specific echelon, that they themselves must understand and determine what is to be done and who is to be assigned? All these issues are complicated, and they cannot be so easily dismissed.

A great deal is being done in the Air Force to increase combat readiness, proficiency, and flight safety. In my opinion the principal areas in this work are the following.

All elements of Air Force combat potential are being upgraded. And this does not only mean new and more sophisticated hardware. It means a search for efficient table of organization structures, study and examination of the most promising modes of combat employment of air forces; substantial intensification of the process of combat training, radical restructuring of all levels of career development of Air Force personnel of various military occupational specialties.

Adoption of computers into all areas of Air Force vital activity is commencing. And once again things do not boil down merely to stuffing units, schools, and scientific research establishments with computer hardware, although this is perhaps an important element. At the present time a scientific approach is being implemented in every practical activity, from processes of command and control of combat operations to effective rehabilitation of the health of Air Force personnel. Not one important decision should be made on the basis of speculative conclusions. Scientific validation, confirmed by experimentation, and practical verification are harbingers of adoption of a new innovation.

First and foremost a material foundation must be placed under each and every problem. There is no doubt, for example, that objective monitoring is a most important element in ensuring flight safety. But is it realistic to perform monitoring and verification "manually," so to speak, during flight operations? At best a commander can look through materials in a cursory manner, as well as asking his subordinate: "Well, how did it go?"

"No problem," the latter will reply. And the commander will give approval for the pilot to go out on another training sortie. It is for this reason that only the most dangerous mishap-threatening incidents are as a rule revealed in the course of flight operations shifts.

Special systems have now been developed to "machine"-process flight data recorder tapes in a prompt manner. The entire cycle has been automated, and the commander is able to examine all essential data to evaluate a training flight within minutes and in a form convenient for analysis. It is true that at the present time there are few such means of immediate processing of flight data. But a production order has already been placed with industry.

A great deal is also being done to ensure safety directly during flight. Work is in progress to provide not only the newest aircraft but also all aircraft currently in service with suitable automated systems by means of equipment upgrading.

Restructuring is in progress in all areas. The system of training aviation specialist personnel of all specialization areas is radically changing. Fundamentally new maintenance trainers are being developed. Assured flight operations weather support systems are being established. Airfields are being reequipped. New flight personnel fitness rehabilitation centers are being built.

Of course it will take years to carry out these programs. But this is not mere playing with problems, but actual solving of problems, even though on a long-term basis. At this moment one can only demand and receive a promise in reply.

I must address this question: is it possible in principle to achieve absolute flight safety against the background of Air Force combat training which is becoming steadily more complex? To provide an answer, we shall break the question down into two parts: is absolute flight safety attainable, and is excessive situation simplification not a reliable guarantee of the welfare of Soviet combat aviation?

A serious reply to any vitally important question cannot be a simple reply. This is also the case with absolute safety.

Hundreds of factors are involved in aviation, factors which are objective in nature and independent of people's volition. Nevertheless this is not a justification. It is the task of aviators to counter these objective circumstances with their own subjective, human, professional energies and abilities. A high degree of professionalism, ingenuity, boldness, and calm can become a reliable obstacle in the path of objective circumstances "attacking" flight safety.

The Air Force bears full responsibility for the state of preparedness of personnel for operations in the most difficult conditions. A focus on absolute attainment of mishap-free flight operations is also possible here. Safety is eloquent in that it constitutes an uncompromising synthesizing indicator of effectiveness of all our labors. If an aircraft is lost during peacetime flight operations, the level of proficiency and combat readiness requires no commentary.

Now let us discuss excessive situation simplification. Let us assume that we have simplified a flight assignment. Time has passed. The pilot has adapted to this maneuver sequence. He has become accustomed to the fact that flying it does not require any particular effort on his part. He becomes mentally disarmed. The moment comes when even a situation-simplified training mission begins to be perceived as working at the limit of one's abilities. Where do we go from here? Further simplification? To what level? Right down to flying in the pattern? In addition, the most dangerous air mishap-threatening incidents occur not where people are working at the highest level of complexity....

Initiative and innovativeness by line-unit flight personnel can contribute a substantial increase to combat readiness, flying proficiency, and flight safety. It is true that there are many complexities here as well. On the one hand many officers in fact suggest effective ways to resolve difficult problems. It is the duty of headquarters staffs to take note of them without delay. Cols N. Litvinchuk and S. Shumilo, for example, developed a new method of objective evaluation of flight safety. It enables one precisely to determine how close a pilot was to a hazardous situation or an air mishap. In addition, Litvinchuk proposed a cadet preflight training system which provides the opportunity to acquire on the ground some of the skills needed in the air. And the entire proposal is realistic. These proposals unquestionably deserve both attention, analysis, and appropriate experimentation. If practical experience confirms positive results, these initiatives must be given the green light.

There are in addition proposals on improving combat aircraft systems, which attracted the designers' interest. But there is another aspect as well, about which we must speak frankly. There are also essentially unrealistic suggestions to be found among valuable proposals which, incidentally, resulted from genuine quest.

One can understand the history of such "innovations." The entire country is in movement, and man's thought has awakened. It would seem that one can merely look around and see specifically what can be changed or improved, either alone or with one's comrades. But why have such modest goals? Lieutenants and captains look even higher—they propose no less than programs to improve combat training throughout the entire Air Force. They demand immediate adoption. They become outraged if the "brass" drag their feet. And it is not only lieutenants, but some higher-echelon officers who are infected with across-the-board reformism. Scores of triumphant reports about all kinds of innovations are received by the Main Staff of the Air Force! But a check reveals that it is really nothing.

One unit, for example, adopted a method of "linear programming of flight assignments." And they immediately sent in a report about it. But how were things in actual fact? It amounted to a blank sheet with ruled lines dividing it into sections: a graphic flight model, an analytical flight model, safety procedures, etc. Filling in these columns is extremely primitive. The sections into which the blank sheet was divided were perhaps fairly well thought out. It does contain certain methodological convenience. One might ask, however, why they employ the term "linear programming" here? And do these innovators in fact know what linear programming is?

In winding up this discussion, I should like to return to the beginning. What are the priority points of the integral triad combat readiness - proficiency - flight safety? I

believe I am correct in stating the following. Debates about "primacy" are nothing but casuistry. Whoever is unable to organize normal flying activities and does not know how to work effectively is very much in need of such philosophizing. If combat training results turn out poor, they blame the restrictions and limitations involving flight safety. If gaps have appeared in flight safety, they claim an endeavor to achieve "outstanding" effect in flying proficiency.

Here is what I think. If a pilot is given the following choice: "You will be a first-class combat pilot, but we do not guarantee safety. Or, as an alternative, we guarantee safety but you will not learn anything about combat flying." Which one will he choose? It seems to me that he will choose other commanders. Herein lies the answer to the question of priorities.

All success derives from people. It is man who is primary in every undertaking. Commanders, staffs, and political agencies must remember this as they organize combat training activities.

Appeal Made For Greater Initiative By Bomber Flight Commanders

91441332b Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 4-5

[Article, published under the heading "For a High Degree of Combat Readiness," by Maj A. Zhilin: "A Great Deal Depends on the Flight Commander"]

[Text] "No, the fact is that the flight commander's role is denigrated here," Capt A. Morozov heatedly argued. "I know from my own experience that this category of command personnel has no opportunity to work productively on training and indoctrination of his subordinates. The main thing is not to drown in the paperwork...."

After my conversation with Andrey Morozov I recalled events which I had once witnessed.

...The bomber flight led by Military Pilot 1st Class Maj N. Artyukhin was to strike ground targets at tactical depth in the "enemy's" defenses. A difficult mission. But if one considers the adverse weather in which the mission was to be flown, the fact of an unfamiliar air-to-ground range and route, as well as the fact that they had to penetrate strong "hostile" air defense, one would not at all envy these aircrews. But orders are orders. They are meant to be executed.

At the designated time the aircraft lifted off and almost immediately disappeared into the heavy overcast. The regimental command element officers who were present at the command post observed with interest changes in the "picture" on the radar display, in which the aircraft appeared as bright green fireflies.

"They are proceeding precisely along their designated route, and they are maintaining the correct spacing," regimental deputy commander Lt Col I. Trifonov commented with satisfaction.

Barely had he spoken when the well-proportioned string of bomber returns on the display proceeded to scatter. An observer at the command post who was uninitiated in military aviation affairs would probably have thought that the lieutenant colonel had put the jinx on them. In actual fact things were proceeding according to plan. The scattering of blips meant that the pilots had commenced maneuvering to evade antiaircraft fire.

At the same time the pilots were performing another, no less important task. Having changed their formation, they were seeking to enter the range area from different directions and altitudes, but at a strictly specified time. This tactic provided an advantage, since the massed strike was to be delivered simultaneously. At the same time this would make it more difficult for the "enemy" SAM sites to repulse the bomber raid.

It was apparent from the display that the two-ship element led by Maj N. Artyukhin was already approaching the calculated point of initiation of the run on the target. The pilots' sure actions left no doubt in anybody's mind at the command post that they would produce excellent bombing results. One of the officers even ironically noted: "The range officer is going to be upset again: all the targets are going to be smashed to smithereens...."

A few minutes later a report on the bombing results was received at the command post. Unfortunately the results were not too good. The range flight operations officer reported that accurate bombing had been performed only by the first two-ship element, the one led by Maj N. Artyukhin. The pair of bombers led by Capt V. Matveyev had failed to master the bombing procedure. When this report was received at the command post, people exchanged surprised glances.

One could understand how the officers felt. Everything seemed to be going so well, and then a bad finish!

But what had happened? They were able to determine the reasons for the failure somewhat later, when the flight data recorder tapes were interpreted. A detailed analysis of the tapes indicated that the pilots of the second two-ship element, when maneuvering to evade antiaircraft fire, had failed to maintain the specified bank angle and G force parameters. As a result lack of precision in their flying technique led to a very substantial error. Captain Matveyev, the element leader, was late in determining his location, and even a violent turn was unable to help him correct his lateral deviation in flight path.

Wingman Sr Lt Yu. Novikov, who was cueing off his leader, of course also erred. In the final analysis the target ended up to the side of the bombers' flight path.

Why was Captain Matveyev unable to maintain the specified parameters in executing the maneuver? At the post-flight critique and analysis session he frankly stated: "Primarily because I disregarded cleanness of flying technique, in spite of the fact that the flight commander pointed precisely to this element on the preliminary preparation day. I knew that the air defense would be simulated, and...."

Major Artyukhin in turn had failed properly to verify the quality of ground preparation by his subordinate, assuming that the squadron commander would do this when checking readiness. As a result the lack of due concern by one individual and a mistake by the other led to failure to accomplish the mission by this two-ship element and to a lower mark for the entire flight.

Penetration of "hostile" air defense zones is one of the main elements of execution of a mock combat mission. It is not difficult to picture the potential result of carelessness or inability in executing maneuver to avoid antiaircraft fire or fighter-evasion maneuver in actual combat. But is an environment and situation maximally approximating actual combat always created during training missions in this type of pilot tactical training? Is the quality of combat maneuvering always frankly and firmly evaluated? We must admit that many times the answer is no.

Examples of this kind indicate a lip-service and careless attitude on the part of some aircrews toward acquiring skills in effective penetration of the potential aggressor's air defense zones. And I am convinced that the flight commanders are to blame for this: they are the ones who superficially monitor their men's performance on the basis of flight data recorder tapes, and it is following their example that pilots simplify their mission. The squadron commander, however, even if he is a genius, cannot keep an eye on everything. It is for this reason that the squadron is broken down into flights, in order to improve work with the flight personnel and to keep a closer eye on their performance. I am forced to repeat the obvious, since I am convinced that some people have forgotten it.

During preparation of combat pilots for a training mission, time is allocated to study and practice of various maneuvers to evade antiaircraft fire and fighter-evasion maneuvers on flight simulators. The tactical situation is depicted on flight charts, the target approach route is mandatorily laid out figuring for penetration of air defense zones, and points of possible encounter of "hostile" fighter-interceptors are determined. But practical experience indicates that, due to excessive laxity on the part of certain commanders, all this is sometimes done in a lip-service fashion—for the inspecting officer. In actual fact, however, the task is substantially simplified, emasculated of the main element—the need to act in conformity with the requirements of actual combat.

We shall be frank: not only pilots are culpable in this. Frequently orders coming from command posts restrict aircrews in execution of maneuvers involving change in flight parameters, while the specified flight level excludes the possibility of vertical maneuvering. In addition, the tactical environment depicted on the map, routes of approach to the target, and maneuvers sometimes remain unchanged for an extended period of time. This leads to the creation of a fixed pattern in the actions of flight personnel, resulting in development of a predictable work pattern at the range.

There is also another restraining factor here. As we know, all flight elements are evaluated according to a four-point system. But execution of maneuvers to evade antiaircraft fire is determined by only two indicators: success or failure to penetrate air defense. An important if not determining element is ignored, namely: how intelligently and effectively did the aircrew pass through the air defense zone? I believe that it is precisely for this reason that ill-considered entries appear in mission logs, indicating that all elements of combat maneuvering were executed in excellent fashion. This signifies in particular that air defense was also skillfully penetrated: the aircraft was not hit by antiaircraft weapons or fighters.

But is it realistically possible to achieve such superstable results, particularly if you are a young pilot who are just beginning to master the combat flying training curriculum? As they say, practice makes perfect.... Analysis of flight data recorder tapes, checking of maneuver parameters and comparison with standard figures indicate that performance grades are sometimes unwarrantedly overstated.

Experience amassed in vanguard Air Force units and subunits convinces us that joint flight operations involving close coordination with antiaircraft missile and fighter subunits constitute a good school for flight personnel to learn methods of penetrating "hostile" air defense zones. And this is quite logical, since one can genuinely hone various elements and test the level of combat proficiency precisely in specific one-on-one combat.

I shall cite an instructive example in confirmation of the above. In the course of a tactical air exercise two elements, led by flight commanders military pilots 1st class Maj A. Valkov and Capt S. Voronkov, were assigned the mission of delivering an airstrike on an "enemy" tank subunit which was about to launch a counteroffensive. Major Valkov, definitely displaying daring, placed all aircrews in conditions in which they had the opportunity independently to select the direction of approach to the target and air defense penetration variation. In addition the flight commander, having analyzed available intelligence, warned his men that the "enemy" might bring up fighter-interceptors on the far approaches to the target. Captain Voronkov, however, proceeded according to the principle of "don't rock the boat."

When the time for the airstrike arrived, Major Valkov's flight swiftly appeared from behind thickly-forested hills. The first pass was a bombing run, carpeting the target

with accurate, closely-grouped bursts. They were followed in by Captain Voronkov's flight. It appeared that they too would accurately hit their targets. But it no longer made sense to fly the bombing run, since the bombers appeared over the range accompanied by a "funeral" escort of "hostile" fighters. This meant that all the bombers in the strike element had been "destroyed." The mock combat mission had failed. The surviving "enemy" tanks inflicted considerable damage on the defending force.

As we see, the conditions in which the aircrews operated were virtually identical, but performance results differed. Nor is this surprising. The leader of the first flight, utilizing terrain irregularities and the position of the sun, effectively accomplished fighter-evasion maneuver, deceiving the "enemy." And, most importantly, Major Valkov was not afraid to take responsibility for bold actions by his men. He was more concerned with the men's proficiency than with his own personal welfare: if they had failed, he would have gotten it! Unfortunately this cannot be said about Capt S. Voronkov who, judging by all indications, had become accustomed to unrealistic simulation and to taking precautions against any possible complications aloft. As a result, although in simulation, he "killed" his men and put the defending motorized rifle troops, for the sake of whom his subunit had flown the mission, into a difficult situation. The fact is that the specific features of air operations are such that not only the aircrews themselves but personnel of other combat arms as well pay for professional mistakes.

As one leafs through reports on combat operations during the Great Patriotic War, one becomes convinced that our bomber crews frequently had to fly missions to destroy enemy personnel and equipment while simultaneously fighting off fighter attacks. This mission was successfully accomplished when aircrews did not restrict their freedom of horizontal and vertical maneuver but acted with initiative, with resoluteness, and even audaciously, in conformity with the prevailing situation.

Experience in the conduct of combat training activities convinces us more and more strongly that the flight commander plays an important role in improving the professional and tactical proficiency of flight personnel. The first steps toward innovative quest on the part of combat airmen are taken precisely here, at the flight level. Brief tactical drills, for example, are very helpful to the flight commander in combat training. Of course, only if they are organized and conducted fully and meaningfully, not merely for the sake of that checkmark on the plan fulfillment report. There is no question that such drills help pilots more deeply grasp the essence of a given maneuver and help them search effectively for ways to improve flying skills. Diversified scenario instructions in the course of a drill session at various phases of flight help develop innovative thinking in pilots and navigators and help them avoid stereotype actions.

Incidentally, precisely such an innovative atmosphere can be observed in Maj A. Valkov's flight. This officer attaches particular importance to tactical training and mastery of the elements of combat maneuvering. A purposeful approach to study of one of the basic pilot disciplines—tactics—has an affirmative effect of his men's combat training. It is not surprising that in the course of tactical air exercises this subunit has time and again displayed initiative, daring, and intelligent boldness.

Of course it is not in all units and subunits that flight commanders have the appropriate conditions and opportunities for working productively with their subordinates. There are many impeding factors. This is a subject for separate discussion. For the moment we should like to state the following. Does it make sense to do as Capt A. Morozov did, going to an extreme and adopting a pessimistic attitude? Is it not better to put up opposition to squadron commanders taking over for flight commanders, as well as opposition to being shackled down by paperwork, utilizing party meetings, various scientific conferences, the unit methods council, and the press as a forum? It is high time to realize that you can't get things moving by "candor in the hallways" alone.

The summer period of training has commenced. Figuratively speaking, the "combat training machine" is revving up to maximum rpm. In order to ensure that it does not run on idle, we must more vigorously combat unnecessary situation simplifications and excessive attention to form with consequent detriment to content, as well as tendencies toward lack of originality and predictable pattern on the part of some Air Force personnel. This is one of today's most important demands, for which flight commanders also bear full responsibility.

Political Officer Uses Instructor Certification in His Work

91441332c Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 6-7

[Article, published under the heading "From Party-Political Work Experience," by Military Pilot 1st Class Col V. Gulyayev: "Certification... To Trust"]

[Text] There was to be a tactical air exercise. Flight by aircrews to an alternate field and organization of flight operations and aircraft servicing and maintenance in field conditions required full party-political support. And squadron deputy commander for political affairs Capt V. Drogin, presenting a report in the regimental political section on progress in preparing for the tactical air exercise, spoke in detail about the work done by him and by the subunit's party and Komsomol activists, and about measures planned for each phase of the exercise.

In describing the political-morale state of personnel, the political worker cited specific examples in showing the men's combat morale. One felt that Drogin possessed

thorough, comprehensive knowledge of the individual characteristics and potential of each man. Incidentally, there is nothing surprising about that. Drogin has long been treated by flight and engineer-technician personnel as one of the guys, as they say. He has many times flown as instructor with almost all the pilots in the squadron.

Today it is not surprising to anybody that the political workers of the squadrons and regiments are certified for instructor work and perform this work at a high level of proficiency. In conformity with the guideline documents which govern flight activities of Air Force political workers, pilots and navigators possessing not only excellent political and organizing abilities but also, as a rule, who have experienced practical professional development in primary-echelon command assignments, are promoted to squadron deputy commander for political affairs.

Many recent detachment and flight commanders and navigation officers are instructor-certified. As for young deputy commanders for political affairs who have not yet obtained instructor certification, the veteran commanders and senior political workers help them accomplish this in the process of daily combat training. It would seem that everybody sees this and is aware of it. Some pilots, however, especially young ones, still believe that there exist restrictions and limitations in the flying and instruction activities of Air Force political workers.

This is not true. In my opinion there are some unresolved matters in the area of training flying political workers, but they are most frequently of a procedural nature. One of my colleagues has for several years now been studying the psychological aspects of the problems of development and improvement of the flying and teaching skills of Air Force political workers. Based on the results of a poll he conducted, for example, approximately 90 percent of the squadron deputy commanders for political affairs consider as the most difficult thing the ability to work jointly with the commander, organizing an effective and high-quality training and indoctrination process, while avoiding doing his job duties on the one hand and becoming a yes-man for him on the other. Most people consider problems of combining flying labor and political indoctrination work as well as interpersonal relations as well as other problems to be temporary, caused by specific circumstances.

Of course it sometimes happens that for various reasons a far from optimal variation of instructor training for a political worker is laid out in the course of planning and scheduling. But an officer who likes to fly and is aware of the need continuously to improve his combat skills will make his presence known to his superiors and senior-echelon political workers. Unfortunately it also sometimes happens that a novice deputy commander for political affairs, upon encountering obstacles and barriers, will simply forget about instructor training, with the reasoning that he has plenty to do without that.

Capt V. Drogin was lucky, one might say. And even before he was promoted to the position of squadron deputy commander for political affairs. Squadron deputy commander for political affairs Maj V. Pershin, one of the regiment's best pilots and instructors, helped him qualify in a new aircraft.

We should state that initially Drogin flew with Maj V. Malgin, who taught his men in a highly unusual manner. He was of the opinion, for example, that the more unexpected simulated situations the instructor presents in the air, the more rapidly his student "will get a feel" of the aircraft. In a general sense this training method is acceptable, and it even has its positive points. But the instructor's mistake lay in the fact that his actions frequently went beyond the bounds of method and intelligent risk. For this reason on one occasion, during formation flying, Capt V. Drogin got into a difficult situation due to an "initiative" by his element leader. After this Maj V. Malgin was temporarily grounded from instructor duties for violation of teaching method and immaturity of views on education technique.

Maj V. Pershin was able to correct his predecessor's mistakes in short order and to qualify this pilot. He demonstrated in practical terms how an instructor should treat his student: with care and with tact, while at the same time giving him the opportunity to display initiative and independence in the air. And we must say that Drogin endeavored to adopt the best elements from the experience and know-how of his new instructor.

A political worker by profession, Pershin stated and worked on not only training tasks in working with Drogin on the ground and in the air. And it was apparent that he saw in his subordinate something more than merely a competent pilot and dependable comrade in arms. Soon Drogin was made a flight commander and elected secretary of the squadron party organization. He now had more work, and more difficulties, but the political officer was always there, helping him with advice and action.

When Maj V. Pershin enrolled at the Military Political Academy imeni V. I. Lenin, Capt V. Drogin was appointed in his place to the position of squadron deputy commander for political affairs. By that time he was already fully trained and prepared for combat flying and to serve as a flight instructor.

These and many other examples from the activities of Air Force units convince one that participation by a political worker in flight instruction broadens his sphere of influence and increases the effectiveness of party-political work, particularly by making it more specific and purposeful, as well as by placing emphasis on an individual approach.

I feel that it is very important to understand well the psychological and pedagogic aspects of the political worker's activities in the capacity of instructor pilot. And it is necessary first and foremost to address his

ability to bring a spirit of strong party-mindedness, responsibility, humanity, and innovativeness into his instruction work.

As we know, tactfulness is a mandatory requirement on a flight instructor. It is doubly important for a political worker. Let us imagine that while aloft he was unable to hold back his emotions and was rude to his subordinate. It is hardly likely that the pilot will not react adversely. He will also most probably share his feelings of resentment with his colleagues. After this will people go to the political worker, ready to open up with their thoughts and concerns? I do not think so. Thus a momentary weakness can adversely affect major factors in the effectiveness of party political work—spiritual closeness, mutual trust, and respect.

I am convinced that vigorous flying and instruction activity enables the Air Force political worker better to study the individual characteristics of the pilots and to guide the men's mood and attitude by means of prompt restructuring of party political work and reshuffling of activist assignments in conformity with the situation and assigned tasks.

This problem should also be examined from another standpoint. Working as an instructor develops in a political worker the habit of constantly analyzing, comparing the results of various flights with the same pilots, comparing their conduct in the air and on the ground, and determining the motives for actions. After all, it is important not only objectively to assess the actions of a given pilot during a given flight but also to reach a synthesizing conclusion: is the officer growing in a military, flying, and moral-psychological respect or is he merely marking time? I consider such an approach essential in order to activate the human factor in combat training, in order to instill excellent moral-political and psychological qualities in Air Force personnel, and for a person's growth as an individual. I shall explain what I mean.

In the squadron and regiment they considered Capt V. Medvedev a proficient pilot. It is perhaps for this reason that instances of carelessness and a poor sense of responsibility by this officer were initially perceived by his superiors and colleagues as a chance occurrence, acts of whim by a moody individual. But as time passed, Medvedev's flying abilities began to deteriorate appreciably.

What had happened? Nothing unusual: this prideful pilot, who was clearly overrating his own abilities, was coasting on past accomplishments and not working on self-improvement. His professional qualities, just as his personal qualities, were not developing. Stagnation and decline were preordained. But they did not happen immediately. It is strange that none of his superiors and none of the political workers who flew dual with Medvedev and had done formation flying with him took note of in a timely fashion or attached significance to obvious signs that something was wrong in this pilot's flying.

The opposite situation occurred with Sr Lt Ye. Akimov. Due to this young officer's poor flying skills, they wanted to put him on an easier aircraft. Akimov's new commanding officer, who had just been assigned to the regiment, went up dual with him and concluded that this fighter pilot possessed the ability, and that it was just necessary correctly to select ways and means of developing that ability. Soon the officer commenced working on a flight familiarization program which had been specially drawn up for him.

Having flown dual with Akimov, I also could see that which I should have noticed earlier: a somewhat weak flying technique, but nevertheless his own individual technique, while at the same time he possessed fairly unique pilot thinking process. I was forced to take another mental note: a political worker who has instructor certification should not judge a pilot's strong and weak points on the basis of what other people say but should have his own opinion on the basis of personal observations and conclusions.

Of course in each such instance training flights with subordinate personnel should be thoroughly thought through and modeled out, in order that they not boil down to a mere garden-variety check ride. A political worker by virtue of his position is obliged to be an educator, an indoctrinator, and a researcher. He should never forget this fact, either on the ground or in the air.

I had no intention at all of boiling down my thoughts, which had been prompted by the decisions of the 19th All-Union Party Conference and the tasks proceeding for Air Force personnel from the party's program points for the present phase of perestroyka and for the future, to a discussion about whether political worker-pilots need instructor certification. Guideline documents give a clear affirmative answer to this question. But I did want to share my experience and ponder the question of whether it is better and more productive for political workers to make use of their instructor certification to increase the effectiveness of party-political work in the squadron and regiment, for the principal tasks pertaining to increasing combat readiness, flight safety, discipline, restructuring of psychology and thinking, and the work style of command, flight, and engineer-technician personnel are performed precisely at this level.

Psychologist Analyzes Causes of Pilot Error

91441332d Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 10-12

[Article, published under the heading "Flight Safety: Experience, Analysis, Problems," by N. Nosov, candidate of psychological sciences, chief psychologist, MSU [expansion unknown], Ministry of Civil Aviation: "The Nature of Pilot Error"]

[Text] **As paradoxical as it might seem, errors by flight personnel are a logical phenomenon. And since this is so, is it always right to link pilot error with personal culpability? In order to gain an understanding of this problem, it is very important to understand the nature of errors in the professional activities of aviators.**

* * *

The problem of pilot errors is linked to one of a pilot's fundamental qualities—professional freedom—and through this with responsibility for one's actions. From the standpoint of responsibility, all psychological views on the nature of faulty actions fall within the framework of the controversial question: free or not free? And they are expressed in two positions respectively, which can arbitrarily be called a "command" position, typical primarily of persons performing executive functions, and a "scientific" position, characteristic primarily of scientists who investigate flying activity.

Representatives of the "command" view maintain that if a person possesses professional freedom, then he bears responsibility for all errors or violations in his conduct. And it is correct to impose punishment for any mistakes, since deviations in free behavior constitute a punishable offense. And as a rule the "individual at fault" is accused of negligence, inattentiveness, carelessness, and absent-mindedness, connected with what in the opinion of his superiors is inadequate understanding of one's responsibility, that is, inadequate manifestation of one's freedom. Since mistakes are made by virtue of freedom, lessening and restricting of freedom of professional behavior is a very common direction taken in efforts to combat them. This is achieved by various means. For example, by increasing the number of formal instructions and regulations governing activities, and by making them more severe. It is assumed thereby that the narrower the "corridor" for possible deviations and the stronger its walls, the fewer mistakes will be made.

Or by reducing the human operator's share in the control process, by an endeavor to reduce his role to a minimum (mere observation, algorithmized button pushing, etc). It is presumed that the less a person intervenes in the control process, the fewer mistakes he makes. Total automation is the maximum limit of minimization of the human operator's role.

Or by formally articulating rigid patterns of correct actions: by constant mechanical rote memorization of current instructions and regulations, by monotonous practice drills, by formal taking of graded tests, etc. It is expected that the more firmly a person has assimilated correct behavior, the less spontaneous that behavior will be.

As experience indicates, however, excessive restriction of a person's professional freedom serves as a source of violations. The mass of instructions and regulations becomes too great and even contradictory. A person becomes alienated from flying with excessive automation. Excessively rigid habits hamper analytical activity. One should observe proper measure when limiting freedom of choice of course of action.

From a "scientific" point of view all deviations arise under specific conditions and are due to specific causes. They arise independent of the freedom, volition, and consciousness of the person who makes the mistake. A deviation is a manifestation of certain natural laws, and for this reason one does not bear responsibility for them. Mistakes do not constitute a person's culpability but rather his misfortune.

Investigations have revealed eight types of psychological explanations of why mistakes occur. Each type of explanation is grounded on specific practical experience and presupposes its own rational method of preventing mistakes.

First. Under some conditions of activity errors occur more frequently than under others. This means that given conditions particularly favor the occurrence of operator mental failures. The most varied factors can have an adverse affect: physical, biological, mental, and social. Or perhaps time of day and influence of the atmosphere. In this case one must combat errors by neutralizing the effect of those factors which promote the occurrence of errors to the greatest degree.

Second. A healthy person performs unwarranted actions in normal conditions. This means that the mind, just as all of nature, functions according to stochastic (probability) laws, which allow for ambiguity and uncertainty of occurrence of any element within a complex system and with normal external conditions. A method of combating errors in this instance is reduction of the share of uncertainty of system functioning. For example, by replacing more "uncertain" elements (control, display, warning devices, etc) with less uncertain ones, in working with which there is less probability of errors due to redundancy of elements, introduction of feedback, etc.

Third. Errors occur under maximum, extreme working conditions. For example, scales are marked off very fine and are hard to read. Or toggle switches are placed too close to one another. Here one should provide normal conditions for performing work activity—bringing the situation to normal.

Fourth. If a situation is complicated even to a slight degree, a person who has been doing a fine job begins to make mistakes. For example, in flying when weather

conditions deteriorate. This means that the pilot lacks proficiency. Individual learning method must be changed in order to prevent such errors.

Fifth. In one and the same situation some individuals make mistakes while others do not. This means that some are capable of performing correctly in any situation, while others are not. Some possess abilities in conformity with the job, while others do not. Hence the method of combating mistakes: selection of individuals with qualities adequate to the given activity.

Sixth. In certain conditions mistakes are constantly made by different people. This means that these conditions are not in conformity with an individual's natural abilities; he is not adapted to them. For example, to perform different kinds of activities simultaneously: flying at low level and simultaneously looking for targets on the ground. It is essential to consider a person's capability to function in such situations and to provide training and practice to develop and reinforce a person's existing attributes in order to make these operating conditions become acceptable.

Seventh. In some cases a person's actions are of a destructive nature. They can also be directed at the individual himself. This occurs because the natural instinct for destruction is inherent in man. In order to avoid such dangerous errors in the work process it is necessary to provide psychotherapeutic treatment to diminish the consequence of this instinct.

Eighth. In a situation in which an individual has performed everything correctly on numerous occasions, suddenly he makes a mistake. This happens because the motivation to perform successfully has diminished for certain reasons. The individual is insufficiently motivated to carry out the specific activity, and therefore is careless in performing it, which leads to errors. In order to avoid such mistakes it is necessary adequately to motivate an individual, to provide him incentive to perform the task, applying positive or negative reinforcement.

We should note that the viewpoints described above are not mutually exclusive. Virtually any event, mistake or deviation can be explained by taking any point of view. The initial axiological position is most frequently determined by one's functional position and job status.

The "command" view ascribes everything to the individual, who allegedly is performing freely at all times, and fails to make a genuine search for the true causes of an error. In this sense as well any error or deviation is considered to be an infraction. The "scientific" view, with reference to the specialist's substantial professional lack of freedom, views any error or deviation as an action which cannot be helped. The individual is thus transformed into a cog or screw, without responsibility, and ceases to be an active, consciously functioning person.

As we see, in both positions only one kind of error or deviation is made: an infraction or an action which cannot be helped. Obviously this is too great a generalization. Let us examine the possible types of mistakes in human activity.

First of all one can say that a person has made a mistake only if he possesses freedom of volition in his job. Otherwise his actions are forced, and he does not bear responsibility for them. Behavior is forced, in the first place, when a person's freedom of action has been taken away and he is proceeding according to a rigid regimen. For example, in response to a direct order or according to the letter of regulations, although he personally may disagree with the order or feels that in the given situation it would be better to depart from the letter of regulations. Secondly, behavior becomes forced when a person by virtue of his nature is unable to control events. For example, when various illusions occur independent of a person's desire and volition. But a person cannot always use objective indicators to recognize the illusory nature of his perception. In such instances as well he cannot be held responsible for performing erroneous actions.

But even with freedom of volition, not every deviation is an error or mistake. Freedom of choice presumes that a person has alternative variations of behavior, each of which leads to a certain result. Focusing on a given outcome, a person makes a choice, thus exercising his volition.

In order to make a choice, a person should understand and be aware of the linkage between his actions and the result or, using a psychology expression, should possess freedom of awareness. There are situations in which the possibility of comprehension is lacking. This occurs in two cases. The first is when the situation does not lend itself to understanding. For example, if an aircraft is in a critical flight configuration, for which the mechanisms of aircraft behavior are unknown, the pilot does not know to what a given action will lead. There is no rational basis for choice. The second case is when a pilot loses his capability of awareness, or when his consciousness is in a critical state. This is possible during hypoxia and during loss of consciousness.

When a person does not possess freedom of awareness, his actions become spontaneous, uncontrolled by the individual in question, and the outcome depends on whether he is "lucky" or "unlucky." Responsibility for the outcome of such situations is borne not by pilot who carried out a faulty action but by that person due to whose fault the situation arose. The pilot himself may also be the initiator. In this case he is indeed responsible for everything.

Thus in the absence of freedom, an action is either forced or spontaneous. Neither can be considered an error if one is guided by the conclusions of science on the nature of man and his activity.

If behavior occurs in a certain situation, where the pilot knows what should be done, how to do it correctly, and

the consequences of an incorrect action, but nevertheless deliberately performs incorrectly, this is not a mistake but rather a criminal act. For example, the first officer sees that the captain is doing something wrong but does not correct him, desiring by this to "punish" him. But it also sometimes happens that the pilot knows what to do but lacks the strength of will and purposefulness. Let us assume that in a head-on pass his nerves break before his adversary's do. This is not a criminal offense and is not an error, but weakness of will. One must treat such an action in relation to who is involved and in what conditions. The person involved should either receive moral censure or moral support and trust. Or, exercising one's commander's volition, impose a restriction on his professional activities.

But if behavior is exercised in an unknown situation, an incorrect action may be either an error based on misapprehension or a mistake made in an attempt to gain a clearer picture of the situation. Misapprehension is observed when a pilot does not know that the situation has changed and is guided by an erroneous idea about the situation (malfunction without warning alert, mistake by another crewmember). An action is a mistake of the latter category when a pilot lacks a clear picture of the situation and attempts to gain a more accurate picture by means of tentative moves.

In order to determine the type of error made, it is necessary to examine the given specific incident, including psychological analysis of the pilot's consciousness and volition: his thoughts, intentions, and tribulations.

Thus a faulty action is considered an error when the pilot who performed the action possesses freedom (otherwise this action is forced or spontaneous), adequately assesses the current situation (otherwise it will be a misapprehension), knows what action in the given instance is correct (otherwise it is a tentative move), and has the strength of will to carry it out (otherwise it would be weakness of will), but for which the pilot does not bear responsibility (otherwise this action is a punishable infraction). In other words an error or mistake is a deviation in performing those job-related procedures which a pilot knew how to execute correctly, was able to execute correctly, and had the intention of executing correctly, and where he cannot be accused of an unconscientious attitude toward his duties (otherwise it would be a punishable offense).

For example, it sometimes happens that an experienced pilot fails to extend his landing gear when landing under the most normal conditions. This is usually attributed to forgetfulness on the part of the pilot. As psychological analysis shows, however, the pilot does not forget about his landing gear, but rather develops a sense of false assurance—it seems to him that he has performed the gear extension procedure, although in actual fact he has only thought about it. This error per se is caused by certain psychological mechanisms inherent in all persons, and there is no pilot personal culpability for occurrence of the feeling of false assurance, which causes him to think that he has performed some action, although he has in fact not done so.

Thus in analyzing flight incidents one should bear in mind that, in the first place, there are various kinds of errors, and therefore the modes of combating them should differ; secondly, there are types of errors for which the pilot does not bear responsibility, since they are caused by factors beyond his control.

This is a conclusion resulting from many years of studying flying activity—a highly unique professional activity. Of course in any specific time period there exist appropriate standards-prescribing documents which regulate all aspects of flying service, including errors. I believe that refining and detailing fundamental concepts is a normal and productive process, for of importance in the final analysis is not whose opinion wins out. What is important is that aviation benefits: in combat readiness, proficiency, and flight safety.

Air Force Needs Thinking Individuals With Initiative

91441332e Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 12-13

[Article, published under the heading "The Reader Continues the Discussion," by Col A. Fedurin, candidate of philosophical sciences: "'Cogs' Are Becoming a Thing of the Past"]

[Text] **The subject raised in an article by Maj Gen Avn A. Bystrov entitled "Democratization of Command and Control: Ways and Methods" (AVIATSIYA I KOSMONAVTIKA, No 1, 1989) aroused extensive interest on the part of this magazine's readers. The author's deliberations on the transition from methods of management by administrative fiat to methods combining command authority and democratic principles are interesting in the opinion of many of our readers and merit active support. Of course the entire complexity of this problem cannot be reflected within the framework of a discussion. What is required here are the combined efforts both of practical experts and scientific specialists of the most varied specialization profile. The author of the following article expresses his view on this issue in a broader aspect. In his opinion democratization of command, control and management is inconceivable without democratization of all vital activities in the military.**

* * *

The new political thinking, implementation of a defensive military doctrine, and a focus on qualitative parameters in military affairs make restructuring and democratization of activities in the military objectively essential. This is dictated by enhancement of the role of the human factor in military affairs and by strengthening

of the interlinkage and interrelationship of the military-combat, military-technical, sociopolitical, spiritual-ideological, and other domains of military affairs, and by increased responsibility on the part of army and navy personnel for reliable defense of the achievements of socialism in conditions of reduction of military forces.

The processes of renewal which are taking place in the party and in society are becoming filled with new content in the Armed Forces. Democratization of activities in the military is a complex, painful, at times conflictive process, and it is a dangerous illusion to believe that it will take root on the basis of instructions from the higher echelon.

In the article under discussion I believe that one can isolate two major constructive ideas. Maj Gen Avn A. Bystrov reveals the negative aspect of command and control by administrative fiat, with the attendant possible manifestation of an attitude of immunity to normal rules and regulations, arrogance, conceit, and deceit at the top, and indifference and depression at the bottom, where the individual is relegated the role of a "cog" who does not pester the authorities with "irresponsible" questions. At the same time, and this is most important, the author shows the necessity for and the vast potential of command and control of military units in a democratic spirit.

The conditions and mechanism of its implementation are not revealed, however. Although the author does point to the main reason for ineffective functioning of the old method—insufficient attention to the human factor—this problem is not fully resolved in the method he proposes. In the article the author places high hopes on sociopsychological studies. But studies do not mean democracy, particularly since, as the author envisages it, they will be organized by the commander and carried out by political workers, with the participation of psychologists, sociologists, and psychophysiologists.

Where are the guarantees that a given person in authority will not continue ignoring the opinion of others? Where are the guarantees that such studies will be carried out at all or will be performed in a lip-service manner? At present there are no such guarantees. If we let it go at that, nothing essentially will change. And this is scarcely an integration of one-man command with democratization and glasnost. In the past as well military personnel in our Armed Forces were entitled to submit suggestions, requests and complaints according to prescribed procedures, and they were entitled to express criticism at party and Komsomol meetings.

I feel that settlement of the fundamental issue of interrelationship between commander and subordinates could constitute such a guarantee. A mandatory poll of personnel when considering promotions in position, rank, etc would be a practical step in this direction. This would ensure not only a formal entitlement but also a moral right to command others and would weaken the rigid dependence of subordinate on commander in matters not connected with performance of tasks pertaining to training. Of course we are not seeking to undermine one-man command or the commander's authority, but rather participation by group wisdom and intelligence at the stage of discussion of the problem of decision making. After it goes into force there can be no vacillations.

The question lies elsewhere. Think about it: do we often encounter instances where a subordinate boldly and frankly criticizes a superior for knowingly erroneous, illegal actions, personal arrogance, or dishonesty? Of course not, for that superior, if he wishes, can "grind him into powder."

In actuality there are many such examples, and we boldly criticize a superior only after he has been removed from his position. But this question is taking on particular importance today. In conditions of reduction of military forces precisely the proposed method of command and control with a democratic spirit will ensure full realization of a serviceman's rights and obligations and his social protection. The opportunity to express one's opinion openly and without adverse consequences should become the norm with the new method. Otherwise the campaign against rudeness, boorishness, toadyism and servility will remain nothing but a slogan.

The new method of command and control will be filled with genuine content if there is genuine democracy in the military unit, when a commanding officer will make decisions on matters of commendation and punishment, career promotion, enrollment in service schools, etc in conformity with public opinion within the unit, not solely on the basis of personal likes and dislikes. Effort must be made in this area as well.

The practice of preliminary discussion when nominating two or three persons for a vacant slot, with subsequent competitive selection, is becoming widespread in military units, a practice which sharply decreases the number of chance, wrong appointments, as well as open discussion of candidacies for award of government decorations. The doors of the "upper floors" must be opened to public opinion within the military community. Every important matter should begin with ascertaining opinions and suggestions pertaining to the matter at hand.

The process of democratization of the military also presumes a new approach to improving the entire system of military labor moral and material incentive. It is scarcely democratic or fair if an officer who does the work of two, is highly enthusiastic about his job, and who displays innovativeness and initiative, and an officer who is merely serving out his time receive exactly the same pay. V. I. Lenin stated that "preferential treatment in shock-work labor also means preferential treatment in consumption" and that "people must be led toward communism not on enthusiasm... but with the help of enthusiasm, with personal interest, with personal incentive."

Here too one can agree entirely with the author of the article that "it is high time to investigate the possibility of employing economic incentive methods in the military by means of intelligent utilization and economical expenditure of funds and resources." Moral incentive alone, when an officer has 25 or 30 commendations, sometimes is not effective.

Suggestions are being submitted by military personnel that monetary reward be adopted not on the basis of year's performance results but on the basis of socialist competition results for the month. It is a pity when some mistake by an officer at the end of the year wipes out the results of his entire labor.

There is a relevant question of whether engineer and technician personnel should be paid on the basis of proficiency rating. It is cause for concern when sometimes engineers and technicians, having for one reason or another lost their future career prospects, cease working actively to raise their level of proficiency rating, even in conditions of conversion training to a new aircraft.

Democratization of life in the military presupposes resolving many problems of daily living conditions for military personnel, because sometimes job-related problems are considerably more difficult to resolve if an officer's family goes for an extended time without its own apartment and is subjected to unsatisfactory living conditions. As special studies conducted in the air forces of a certain military district indicated, officers would be willing to accept difficulties and wait for their resolution if there were greater glasnost and social fairness in distribution of that which is available. One is concerned, however, by the fact that 45 percent of those persons polled feel that the command authorities are indifferent toward suggestions by personnel on all these issues.

The new method of command and control presupposes a high level of responsibility and discipline. And it will ensure such a level. A healthy moral-psychological climate in the unit and an atmosphere of mutual demandingness and public condemnation of law violators create more favorable conditions for this than outright rule by administrative fiat and harsh punishment. It was ascertained in the course of the poll, for example, that approximately 80 percent of flight personnel, engineer and technician personnel do not admit culpability in a flight mishap-threatening situation, fearing party and administrative punishment. This is extremely dangerous in conditions of learning to operate, servicing and maintenance of highly-complex modern aircraft. Apparently a solution should be sought in encouraging observance of standards of military honor and ethics.

To date perestroyka and democratization have had little effect on improving the labor of military cadres. More than half of the engineers polled stated that the bulk of their job-related activities consists of working according to regulations and formal procedures, which requires no innovativeness even during the period of mastering servicing and maintenance procedures on a new aircraft. About 70 percent feel that from one third to one half of their time on the job is spent performing tasks which do not require engineering training (running errands, handling supply, paperwork, and bookkeeping).

The author's thoughts pertaining to reducing, in light of the demands of the USSR Minister of Defense, the number of various directives, orders, and instructions ring with strong relevance in connection with this, as well as his ideas pertaining to rescinding those which duplicate existing regulations and which frequently are in conflict with current regulations. As practical experience in the line units indicates, the stream of report and record keeping documentation as well as other papers could be reduced by a factor of at least two or three in the interests of efficiency. And this problem can be fundamentally resolved only with resolute measures taken at the higher echelon.

Success in adopting the new method depends to a determining degree on the ability of those exercising command and control, that is commanders of all echelons, to work in the new conditions, to improve their work style and methods, and to teach democracy both to themselves and their subordinates.

All this requires up-to-date training, profound knowledge of military affairs and theory of management, command and control, and the appropriate leadership skills, abilities, and qualities. Conducted sociological studies persuasively attest to the fact that many young engineers, who are successfully performing their job duties, encounter considerable difficulties in working with others. Some of them frequently "are afraid to approach" primary-rank enlisted personnel and are unable to conduct training classes not only on political but technical subjects as well.

Apparently the problem is that Air Force higher educational institutions are presently doing a poor job of preparing aircraft maintenance specialists as leaders and instructors of subordinates. The departments of social sciences, aircraft maintenance, flight safety, and aerodynamics provide only fragmentary knowledge on theory of management, training and indoctrination. There is no coordination among departments. I feel that it is high time to introduce a special course on military engineer management and indoctrination activity. It should be given in close coordination with specialized subjects. There is capability to offer such a course. In the department of Marxism-Leninism at the Military Air Engineering Academy imeni N. Ye. Zhukovskiy, they have developed a combined curriculum for training highly-knowledgeable, comprehensively-developed military aviation engineers and genuine officer-leaders. The next step is to adopt this curriculum.

Matters pertaining to scientific organization of the selection process for enrollment in service schools and academies and prediction of the professional suitability of future commanders and their future ability to be a leader

and indoctrinator are presently a matter of considerable importance. It frequently happens that good technicians, even after graduating from the academy, turn out to have weak leadership qualities. What is needed here are reliable methods of determining a person's ability and aptitude to work with others. But it is also important to have a decent selection pool. And this means that it is necessary to increase the social significance of military labor and its prestige, which unfortunately is declining among young people.

In conditions of focus on qualitative parameters in military affairs, democratization of glasnost in the military community, of primary importance are not "cogs" who are willing to follow without thinking any obsolete regulations and formal instructions, but rather individuals capable of carrying out the orders and instructions of their commanders and superiors consciously and with initiative. It is these individuals who will put specific content into the proposed method of command and control in a democratic spirit and who will raise combat readiness, flight safety, and military discipline in the Air Force to new heights.

Readers Ask About Tactics

91441332f Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 14-15

[Article by Col V. Bondarenko, candidate of military sciences: "Tactics Presupposes Innovativeness: Military Scientist Comments on Letters to Editors of AVIATSIYA I KOSMONAVTIKA"]

[Text] **In their letters to the editors, many readers refer to articles published in this magazine pertaining to problems of tactics. We asked Candidate of Military Sciences Col V. Bondarenko to comment on some of these letters and state his view on the issues addressed.**

* * *

From a letter by Lt Col Yu. Priymak: "...I liked very much the article by Lt Col V. Gryaznykh entitled "Innovation... Without Secrets and Sudden Inspirations" (AVIATSIYA I KOSMONAVTIKA, No 9, 1988). This article gives an idea on what phases military science passes through before a practical recommendation appears on the basis of which a tactical move can be developed.

"But I should like to read about how a pilot, in line-unit conditions, should look for a reasonable sequence of actions against a specific tactical problem—this is what is most of interest to us."

One can scarcely suggest any one universal method of solving various tactical problems. One can only state several observations dealing with application of already-developed models, as well as pertaining to method of combat modeling and simulation.

Air-to-air combat, as a highly complex field of human activity, always assumes the form of conflict situation. Each side pursues its own objectives and selects a given mode of conduct in order to attain those objectives. The outcome of battle depends on the decisions made by the adversaries and on who has better and more fully implemented his capabilities.

Combat also has its own characteristic patterns and mechanisms, which are distinguished by form of cause-and-effect relations and are subdivided into regular (determined), probable (stochastic), and conflict. While the first produce unambiguous results, the second and third provide only rough orientation in predicting the outcome of a given phenomenon or event. The result of manifestation of the patterns and mechanisms of the second group can be affected by introducing any conditions, restrictions or limitations. Let us say, for example, that the probability of destroying a non-maneuvering target with an air defense weapon is 0.8, while the probability of destroying a maneuvering target is less by a factor of almost two.

On the other hand, while the first two groups are patterns and mechanisms of nature, that is, they do not affect relations between persons, the third group of mechanisms reflects precisely such relations.

The patterns and mechanisms of conflict take into account insufficiency of information on the adversary's actions and the need to make a decision in conditions of uncertainty.

Modeling methods which use the first two groups of patterns and mechanisms of combat are presently the most fully developed and are the most widely employed. Science is also now very close to using the third group as well in modeling. A decisive role in this should be played by game theory—an area of mathematics which directly reflects the specific features of conflict mechanisms and objective reality where it is not possible to apply traditional mathematics. This will provide a new forward impetus in modeling and will make it possible to encompass a considerably greater number of factors and sharply to increase the reliability of predicted results.

From a letter by Capt V. Gulin: "An article by Col V. Shubin entitled 'From Tactical Prediction to Victory' (AVIATSIYA I KOSMONAVTIKA, No 8, 1988) states: 'Today a large number of factors influences the result of combat. The very nature of manifestation of each specific factor is also becoming more complex.' This is followed by a conclusion to the effect that the pilot cannot create a reliable analogue to that situation which he will encounter and in which he will be functioning in actual combat.

"I would like to learn more detail about just what these factors are? Would it perhaps be useful to classify them?"

Elucidation of the factors which characterize military operations are of considerable scientific interest. Their systematization and classification, consideration and

prediction of changes in large measure also determine the development of tactics as a whole.

An article by Commander in Chief of the Air Force Mar Avn A. Yefimov, entitled "Aviators of the Revolution: 1918-1989" (AVIATSIYA I KOSMONAVTIKA, No 2, 1989), advances a new synthesizing formula of air-to-air combat: information - space - maneuver - fire. This formula synthesizes the four most important groups of factors.

But one should note that we can include both natural factors and all that which characterizes the adversary among the circumstances which are attendant to combat. On the whole the question of systematization and classification of factors applicable to given types of combat is in my opinion a topic which merits separate, detailed discussion in this journal.

Maj G. Zarev shares his view: "I consider materials on tactics to be interesting and useful. But greater attention should be devoted to particular questions. How many tactics should a combat pilot fully master in order to feel confident?

"Nor should we forget the major issues. What leading trends determine air-force tactics todays? What will change in three to five years?"

This magazine periodically publishes materials which determine general trends in development of air-force tactics over a certain period of time. A number of articles dealt with this subject in 1988 and in the first issues of 1989. Unquestionably more specialists should be drawn into discussion of these issues, and a debate should be conducted. It is also desirable that readers take part in the discussion and not merely wait for ready formulas and advice. One must learn to synthesize information, to elaborate one's own opinion and to be able to defend it and, most important, to implement it.

My views on the uniqueness of modern tactics are as follows. The development of tactics is determined entirely by improvement of the "human operator - combat equipment" system. The second component of this system—combat hardware—is developing the most vigorously. For this reason in studies conducted in recent years determination of the paths of development of tactics has been done primarily by comparing the capabilities of hardware.

This area is most readily amenable to processing with mathematical methods, while a lack of real-conditions verification of the correctness of the points of tactics in combat has made it somewhat one-sided and made it "machine-centric."

The search should apparently be shifted into the area of development of the first component of the system—the human operator and his mental activity, to problems of organization and management of equipment in combat, and to matters of effective realization of the capabilities of one's combat aircraft and decreasing the effectiveness of the enemy's combat equipment. At this stage of development of arms, when weapons based on fundamentally new physical principles have not yet actually entered the arsenal, tactics should once again become "human-centric."

I should now like to discuss reserves of tactical moves. In all domains of activity there are no limits to improvement. Any military specialist who has stopped and is resting on his laurels is passed by his comrades, and in battle he will be knocked out of action by his adversary. Although one can state with assurance that even a single tactic is sufficient for victory if one succeeds in effectively utilizing it in combat, in a specific situation.

Capt Yu. Karev writes: "I am waiting for an unambiguous answer to the following question: By what should a pilot be guided in air-to-air combat—by the combat environment or the tactical situation? This magazine formulated the problem and designated the question, but it has not yet provided an answer."

Yes, this magazine did state the question, which merits discussion and further study and development. One should also further refine and detail these terms: combat environment [boyevaya obstanovka], and tactical situation [takticheskaya situatsiya].

The method of breaking down any process into individual phases and fragments is employed fairly extensively. The author of the article "Combat Environment or Tactical Situation?" (AVIATSIYA I KOSMONAVTIKA, No 12, 1988), demonstrated on the basis of a single example the essence of situation modeling in selecting a rational combat tactic. In addition, he proposed a variation of synthesis and inquiry to find the patterns and mechanisms which characterize the actions of element leaders and pilots in all phases of air-to-air battle. They have a common component in that both the element leader and his pilots should continuously possess an integral picture of the nature of the forthcoming combat engagement and their role in it, taking into account the commander's decision.

The sole difference lies in volume of information being processed. One can therefore state the following supposition: the tactical situation for the element leader becomes the combat environment for the pilot. The combat environment for the commander is formed of a specific combination of various tactical situations.

These categories are close and interlinked, mutually transitioning into one another. It is therefore important to establish into what tactical reality a specific combat pilot is being placed. The success of combat operations depends to a considerable degree on the correctness of the answer to this question.

Sr Lt F. Zagoskin expresses doubt. "Does it make sense to divide 'samostoyatelnyy poisk' [roving fighter combat; fighter sweep; threat search without ground radar assist or GCI] and "svobodnaya okhota" [roving patrol; target-of-opportunity roving; roving fighter

combat tactics; fighter sweep] into two modes of combat operations? In my opinion there is no good reason to do so."

The reasons for separating these modes is the fact that they are grounded directly in their name and are determined by a specific principle.

In my opinion Cols V. Poluektov and P. Isayev, in an article on this subject (AVIATSIYA I KOSMONAVTIKA, No 5, 1988), presented in sufficient completeness and detail the common features and fundamental differences between these terms. Modern fighter aviation has substantially broadened the framework of its combat tasking and has become a means of destroying not only threat aircraft. There is always the possibility of development of a situation in the course of combat operations whereby it will be more important to obtain information on the enemy in a specified area than to destroy a given enemy aircraft. Everything will depend on the specific combat mission. Hence the different manner and sequence of its execution.

Pilot's Wife Claims Spouse Treated Unfairly

91441332g Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 16-17

[Letter with commentary, published under the heading "Reader-Magazine-Reader": "'I Am Not Happy About Anything Right Now': Letter With Commentary"]

[Text] Esteemed Comrade Yefimov! I would not have ventured to write you if it were not for your article (AVIATSIYA I KOSMONAVTIKA, No 12, 1988). This is the first time I have ever written a letter of this kind. At the very outset let me beg your forgiveness for taking up your time. I would like to share my thoughts, even if I am wrong. There is no need to reply. I am not naming names, since this is not a complaint and is not a request.

Our story is as follows. My husband, Fedor Ivanovich Ivanov, graduated from the Stavropol Higher Military School for Pilots and Navigators [Air Defense Forces school] in 1980. We were stationed in the Far East for almost five years, after which our regiment was placed under Air Force command, and the pilots were conversion-trained over to a different type of aircraft.

My husband's job was proceeding just fine, and relations within the unit were excellent. We had no complaints. He was slated for promotion, but suddenly personnel replacement commenced in our regiment, which had not occurred for a long time, and in 1985 we were reassigned to the Group of Soviet Forces in Germany.

I came later to my husband's new duty station. I did not recognize him. He is usually calm, composed, and with a lively interest in a great many things in addition to his job duties. But when he met me and our daughter he seemed harried, nervous, and somehow somber. He didn't seem to be glad or happy about anything. And this was after just two and a half months.

I had the good fortune to find a job immediately (I am a stomatologist). Upon becoming acquainted with the military post and relations between people, I realized that not everybody had come here to do a good job; many had come to live in comfort and luxury.

The regimental commander did not trouble himself to be nice to the pilots. From his very first day on the job my husband was constantly the target of caustic remarks and jokes. In short, they were trying to show him that people transferring from the Air Defense Forces to the Air Force are not worth a damn.

Before one flight my husband's commanding officer said to my husband in a mocking tone (this had become a ritual): "Well, air defense, show us how high you can fly!"

I know my husband and I can state that his nerves were just about at their limit. But he went up. Fortunately he returned safe and sound. But he had a near-mishap incident. After he landed, the first thing he heard was abusive cursing, choice cursing by his commanding officer. I alone know what he was thinking, what he felt, and what he said.

That day when he came and told all was his most terrible ordeal. He kept repeating: "I was seething. I wanted to prove to them what I could do."

By morning my hair had turned half grey. Forgive me the details, but I want to get it all out at once. We made a decision at that time or, more accurately, he made a decision, and I supported him: to leave the military. It was not yet too late to get an aviation institute degree and work in aviation, but not military aviation. After that he began receiving orders to report to the regimental commander.

If you only knew how the commanding officer forced my husband to word his resignation request! It had to read the way the commanding officer wanted it to read. If the commanding officer had not been so insistent, perhaps my husband would have long since been out of the military. In response to his demands, my husband submitted a request for transfer to a rotary-wing unit, to which the commanding officer replied: "You'll never fly for me again. I'll write you an efficiency report so that no rotary-wing unit will take you."

At this point a higher-echelon commander arrived at the garrison. He is now back in the USSR, but I always remember him with warmth. Learning about what had happened, he summoned my husband and had a talk with him. After a friendly, kindly conversation my husband was unrecognizable. He came home on cloud nine. But since I was now against any kind of military flying career, I was also asked to come in for an interview. I did not go, however, and we transferred to

another regiment, where my husband was given the opportunity to fly—after all, he was already 2nd class.

Unfortunately the efficiency report claiming pilot Ivanov's "mediocrity and ignorance" arrived in this regiment soon after we did. My husband did practically no flying at all for almost a year, until the regimental commander was replaced. If any changes were to be made in the flight operations schedule, his name would always be crossed out. He was last everywhere and at all times. But he patiently bore his "cross": he did get to fly, although seldom.

When the new regimental commander took over, things changed radically. A great deal was accomplished in 1988. The squadron commander, his deputy, and the others became transformed, helping my husband in all things. At the beginning of January 1989 a picture of my husband appeared in the newspaper SOVETSKIY PATRIOT, with the caption: "Taking part in scheduled flight operations and tactical air exercises, this officer displays a high level of flying, weapons, and tactical proficiency, and the ability calmly and intelligently to maintain his bearings in the complex environment of modern air-to-air combat.... All these traits enabled him to end the training year virtually fully proficient to the 1st-class level."

A week later some people from the personnel section came around. They were interested in learning what the pilots thought about conversion-training over to a new aircraft. It was like a mockery of fate. My husband would be taking the examination for 1st class in three or four weeks, and he requested the opportunity to complete the final required training flights. Three days later we were hit by a bolt of lightning: "No conversion training for Ivanov. Decision of the senior commander. No more flight duty for him. It is time for promotion to major and for transfer to ground duty." That same day his name was crossed out of the flight operations schedule, and he was sent off on a TDY assignment.

The squadron commander and deputy commander repeatedly went to the regimental commander and made requests on behalf of my husband, for they were aware how long and hard he had worked to earn 1st class. Their efforts were in vain. Now everybody is waiting to see if he will be able to get away from his TDY assignment and get to Moscow, to the Air Defense Forces Personnel Directorate. He will be pleading not only his own case. In short, a "purge" of flight personnel is in progress, and they are "purging" primarily the younger pilots, such as my husband, who is presently 29.

They immediately brought up his pilot error in 1985 and his efficiency report. But the years teach a person something. He analyzes and interprets a great deal anew. I agree with you. But why are we now forced to rehash this ancient history, which has suddenly been thrown back in our faces? The kindness on the part of the regimental commander disappeared overnight. Even during his receiving hours for personal matters he would not listen to my husband, although he was the only one signed up to see him.

I don't know if my husband will accomplish anything. A "wall" has formed around him. The regimental commander said approximately the following to my husband: "You flew so high, and now you want to nosedive into the ground?" This in response to a request to complete the requirements for 1st class.

I really hope that you will read my entire letter.

My husband tried to make an appointment to see a member of the military council; they gave him a nonexistent telephone number.... If he cannot get to Moscow, one of the men on leave will head for Moscow and go to the personnel directorate. He will go on behalf of everyone.

Believe me when I say that there is no joy in my life right now. I am far from family and loved ones. My husband and I have always endeavored to make it on our own in life. It is very difficult for people in our position. This is evidenced by the foolishness uttered by the regimental commander. "Orders from higher up. I advise you not to pursue the matter at the higher echelons!"

I closely followed the proceedings of the 19th All-Union Party Conference. It turns out, however, that these were mere empty words. I do not believe in perestroyka in the military; it should not be proceeding in this manner. But that is my purely subjective opinion.

I have taken up enough of your time. I wish you all the best! And, most important, good health, for herein lies a guarantee of all our successes. Time is an extraordinary thing; time puts everything in its place. In the final analysis life is always fair. You were correct in stating: "Our life is changing rapidly. Sometimes the changes are not readily apparent, but they are indisputable."

Respectfully yours, Tatyana Viktorovna Ivanova.

* * *

Commentary by Commander in Chief of the Air Force Mar Avn A. Yefimov

The above letter was sent to me in care of the magazine AVIATSIYA I KOSMONAVTIKA. Unfortunately I was unable personally to meet the letter's author, the wife of a pilot. I would like very much to hear out this far from indifferent woman, a real officer's wife. I would also like to look into the face of those commanders and superior officers who have such a cavalier attitude to the career fate of those persons serving under them.

I assume that some of the things in Tatyana Viktorovna's letter are painted with a somewhat heavy brush. She herself specifically states that she may be wrong on some points. It would be strange if an absolute balance of

feelings and logic were maintained in one's thoughts about the fate of a loved one. In any case I understand her very well.

I would like all command personnel to grasp this simple truth: these are not "units of manpower" but living persons with whom you are dealing, people with character and personality, individuals with a world-view, with dreams and hopes, with faith and pain. Each one has his plans and those dreams which have not materialized.

We always have a great many problems, particularly at the present time. And they are all difficult. Take, for example, reduction of military forces. It cannot help but affect the lives of hundreds of Air Force officers, officers of various ages, with various career and life experience. It can result in a great deal of unfairness if one approaches purely arithmetically this human and most fair—in sense and purpose—decision by our homeland. A great deal of worldly wisdom and military-professional wisdom will be required of command personnel, who are responsible not only for combat readiness but also for each individual under their command. With all the diversity and complexity of our problems, the problem of the individual is the most complex. We must never forget this fact, never for a single instant.

As for Tatyana Viktorovna's letter, an appropriate decision will be made.

Air-to-Air Combat Management Algorithms

91441332h Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 24-25

[Annotated diagram: "Air-to-Air Combat Control Algorithm"]

[Text]

Pilot Makes Night Landing With Lights, Instruments Out

91441332i Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) p 28

[Article, published under the heading "Flight Safety: Emergency Situation," by Col (Res) N. Gostev, Honored Military Pilot USSR: "Not Covered by the Manual...."]

[Text] Flight operations involving regular-assignment flight personnel were being conducted in one of the training regiments at the Borisoglebsk Higher Military Aviation School for Pilots. The pilots would be performing the difficult mission of night bombing. Quite understandably this imparted a highly-dynamic character and a special moral-psychological intensity to the flight operations shift.

Instructor pilot Capt V. Mamayev climbed into the cockpit for the third time. This time he would be practicing level bombing. A few minutes later his aircraft lifted off and streaked skyward. Everything was proceeding normally. It was a short distance to the range. He could already see the familiar lights serving as points of reference. Soon the pilot also spotted the target. He radioed: "...On final target heading! Target in sight." A little later: "Bombs away!" The job finished, he put his arming switches on safety.

Captain Mamayev had accurately placed his bombs into the target, and for this reason he was in a buoyant mood. At this point he did not know what awaited him on the return flight.

Thirty-eight kilometers short of the field, all electrically-operated instruments suddenly failed, as did the instrument lighting. The emergency lighting was also inoperative. The cockpit was enveloped in blackness. If there had been a moon, he could have gotten his bearings. But there was no moon. It was the worst situation one could imagine.

The pilot wanted to report the situation to the tower, but he realized that this was impossible. His headset had gone dead. The radio was out. He could not expect help from anybody. Mamayev was on his own facing a situation not covered in the manual. What should he do?

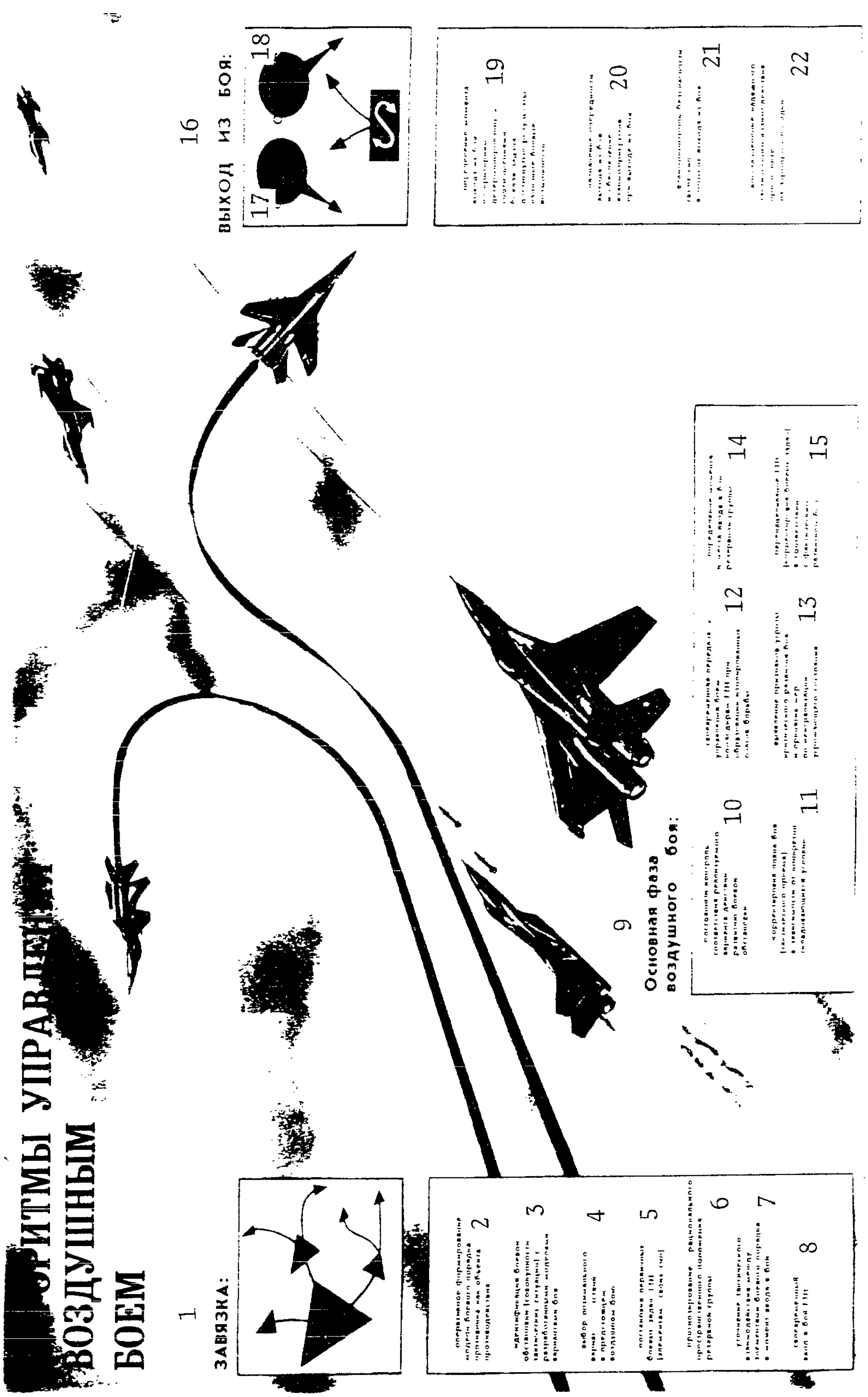
Captain Mamayev forced himself to become calm and to assess the situation. Although it was night, he shifted to flying by visual reference. He proceeded to approach the field on the basis of familiar lights serving as points of reference. When he spotted the runway lights, he said to himself in relief: "At least I've got the runway in sight."

Observing due caution (his radio was out, so that he could not know whether anybody was on a landing approach), he entered the pattern at a safe altitude. He turned onto final, descended smoothly, and flew a pass over the runway. It was difficult to see the aircraft from the ground, however, since his aircraft position lights were out. The flight operations officer only heard the fighter's engine noise. He realized that there was an emergency in progress.

The runway-end floodlights were switched on. The moment of truth had arrived—the landing.

It is no secret that night flying is done by instruments in combination with visual reference. Capt V. Mamayev realized how difficult it would be to land solely on the basis of his visual perception of the aircraft's position in relation to the ground. If only one of his vitally important instruments was working! If he only knew his airspeed or altitude! But there was no information available. There was no other choice: he had to risk a visual approach and landing.

After performing emergency manual nose gear extension, the pilot proceeded to set up an approach to the emergency unpaved runway. At this moment he was only


ВОЗДУШНЫМ
БОЕМ
1
ЗАВЯЗКА:
2
3
4
5
6
7
8
9
Основная фаза
воздушного боя:
10
11
12
13
14
15
16
ВЫХОД ИЗ БОЯ:
17
18
19
20
21
22

Key:
1. Preengagement
2. Practical forming of a model of the adversary's formation as a target of countermeasures
3. Identification of the combat environment (aggregate of tactical situations) with elaborated battle variation models
4. Selection of optimal variation of actions in forthcoming air-to-air engagement
5. Assignment of primary combat missions to tactical elements
6. Prediction of reasonable positioning of reserve element
7. Refining of tactical coordination between formation elements at moment of engagement
8. Timely engagement of tactical elements
9. Principal phase of air-to-air combat
10. Continuous monitoring of conformity between executed variant of actions and development of combat situation
11. Adjustment of battle plan (tactical move) in relation to specifically developing conditions
12. Timely handoff of tactical command and control to the tactical element leaders when isolated areas of combat form
13. Ascertainment of signs of threatened critical development of combat and taking of measures to neutralize a threatening situation
14. Determination of moment and place of engagement of reserve elements
15. Retargeting tactical elements (adjusting combat missions) in conformity with actual development of the combat engagement
16. Disengagement
17. Target 1
18. Target 2
19. Determination of moment of disengagement according to criteria determined by the correlations: combat mission—achieved results—available combat capabilities
20. Designation of sequence of disengagement and securement of mutual cover during disengagement
21. Mutual monitoring of security of friendly forces at moment of disengagement
22. Reestablishment of reliable tactical coordination during flight to destination fieldthinking about one thing: to execute his final approach descent with maximum precision and to approach the runway at the proper airspeed! Any mistake promised irreparable consequences. In addition to skill and self-control, a great deal would be determined by an element derived from these qualities—intuition, the ability to sense the slightest changes in the aircraft's behavior.

The aircraft was rapidly approaching the ground. Since the floodlights were illuminating the main runway, the emergency runway was only dimly visible. The flight operations officer had not thought to direct even a single floodlight toward the unpaved runway. Mamayev, peering intently at the ground, concentrated his entire attention on putting the aircraft down as softly as possible onto the nose gear and belly tank.

Ground contact! The aircraft lost speed and came to a stop, tilting like a crippled bird. This officer had passed a most difficult test. But there is more to the story. Just what helped Capt V. Mamayev, a pilot 3rd class, who had logged only 18 (!) solo night flights, emerge from this emergency situation with honor? Many even 1st-class combat pilots could not handle such an ordeal.

The school's deputy commanding officer, Col V. Serdyuk, had the following to say: "There is a certain logical pattern here. The fact is that we constantly devote attention to flying methods work particularly with the young officers. Only those who have sufficiently thoroughly mastered flying technique, navigation, and weapons delivery are allowed to fly at night. Captain Mamayev fully meets these requirements. In addition, the correctness of the methods used in practicing on the simulator and in the cockpit, during which pilots rehearse in-flight emergency situation response procedures, has been confirmed. As a result Mamayev only needed a few seconds in order manually to extend his nose gear, while continuing to pay attention to his flying...."

One must agree with Col V. Serdyuk's assessment. It may sound trivial, but practical experience convinces one again and again that you will perform in the air according to how you have prepared on the ground.

For his skilled actions, courage, composure and presence of mind displayed in an emergency situation, Capt V. Mamayev received a commendation from the commander of air forces of the Moscow Military District.

Evaluating Combat Navigational Environment

91441332j Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) p 29

[Article, published under the heading "Into the Military Airman's Arsenal," by Col (Ret) K. Chemarda, candidate of military sciences: "Navigational Environment—Factor in Combat"]

[Text] What military aviator is not aware that the quality of performance of training missions depends in large degree not only on professional skill and psychological stability, but also on the navigational environment in

which the flight takes place? Incidentally, it exerts considerable influence on the combat capabilities of aircrews and Air Force subunits as well as on flight safety.

Organization of pilot combat activities is grounded on comprehensive environment and situation assessment, including the navigational environment, which frequently determines choice of mode and the entire sequence of mission execution. It is therefore very important thoroughly to understand the essence and content of the navigational environment taking into account concepts of modern air combat operations.

The navigational environment is an aggregate of all external factors exerting influence on navigation and determining conditions, capabilities, accuracy and reliability of performing the tasks of flying aircraft and air subunits in an area. The structure of this concept includes first and foremost the external environment in which aircraft operate, with inherent natural factors (landmarks and reference checkpoints, geophysical fields, meteorological conditions, natural lighting), plus the working fields of radio navigation systems, as well as lighting and illumination with which the area of operations is equipped.

But not only these traditional factors determine the conditions of solving navigation problems. The capabilities, quality, and reliability of combat air units are determined by a number of operational-tactical (combat) factors. It is easier, for example, to accomplish navigation tasks when facing little hostile fire and electronic jamming efforts than in the case of heavy fire and electronic jamming countermeasures. And this is not only due to the psychological stress and greater workloading on the crew but also due to the presence of jamming interference, dummy or decoy targets, the need for additional violent maneuver, a longer route to the target, diverting the route away from a navigationally advantageous axis of approach to the target, from a direction which is not always optimal from a navigational standpoint, increased probability of failure of onboard navigational equipment as well as possible restriction both on the flight proper and on navigational equipment utilization mode.

Operational-tactical factors also complicate conditions of flying and navigating. All these difficulties affect the actions not only of the adversary but of friendly forces as well. In particular, electronic jamming, radiologically-contaminated areas, flooding of large areas caused by the destruction of levees and dams, destruction of landmarks and reference-point objects, etc, are affecting factors over enemy territory.

Navigational environment elements also include such factors as flight restrictions or limitations dictated by the combat situation; specific en route corridor and authorized range of altitudes, and orders prohibiting use of presence and location revealing airborne navigation equipment.

Navigation of combat subunits proceeding independently differs substantially from when they fly as a formation element of a large force. This is connected with restrictions on maneuvering, which diminishes capabilities and increases difficulties of correcting navigational errors, creates mutual electronic interference, and produces additional navigation problems. As a result, the navigational environment of a flight involving several aircraft or elements may differ substantially in list of determining factors and degree of complexity from the conditions of independent, separate execution of a combat training sortie.

Mission-supporting measures also constitute elements of the navigation environment. For example, en route or target marking, target designation, guidance to target by leading aircraft, and information on actual en-route winds aloft. Some lend themselves to purposeful action by mission organizers. For example, on the basis of a situation evaluation which reveals inadequate navigation support, man-made reference points or navaids (route markers) can be established, additional navigational systems can be switched on, certain enemy weapons and jamming facilities can be knocked out of action, etc by decision of commanders at the appropriate echelons. The initial navigational environment may be improved as a result.

Navigational factors dictated by mission restrictions and constituting implementations of support measures are entirely controllable.

Finally we should note that mission organizers and aircrews are interested not in the overall navigational environment but only in those elements which will affect mission-specific navigation. This means that the navigational environment also determines the composition and content of navigation problems and tasks at each stage of the flight.

We shall assign all the above factors to four groups.

Natural-geographic: the ground surface; natural landmarks and terrain features; villages, towns and cities; man-made landmarks and ground features; tall structures; density, distinguishability of and distance from which landmarks and reference points can be spotted; magnetic and gravitational geophysical fields; natural illumination.

Hydrometeorological: weather systems; weather fronts; cloud cover; precipitation; other atmospheric phenomena; visibility (visual, TV, radar); wind, winds en route and winds aloft; sea state; tides; barometric pressure and air temperature along route segments and at various altitudes.

Technical: navigation aids en route (ground, afloat, satellite); location of zones of differing accuracy of navigational readings; reliability of radio facilities and their degree of immunity to or protection against jamming and other interference; topographic and geodetic support.

Operational-tactical (combat): conditions of basing; restricting and limiting zones and areas; barrage balloon screen deployment areas (friendly and hostile); enemy radar detection, defensive fire engagement and electronic countermeasures zones; anticipated opposition and degree of its suppression or neutralization; protection by electronic jamming against enemy detection and attack; available ECCM capabilities to protect friendly navigation gear; radioactive contamination zones; anticipated physical change on the ground as a result of combat activities (destruction of inhabited localities and structures, flooding of areas, smoke screening or filling of areas with obscuring smoke); dummy or decoy installations, vehicles, etc; radar spoofing; camouflage and concealment; probability that the enemy will destroy an area's navigational aids; threat of incompatibility of radio equipment and facilities; formation and position in formation; restrictions on employment of navigation equipment, aids and facilities; availability of navigation-assisting weather reconnaissance, winds en route, marking, target designation.

Some of these factors, especially meteorological and operational-tactical, are not known in advance, are uncertain and unreliable. They must be skillfully predicted. Such a forecast is mandatory in order to determine the navigational environment.

The makeup and composition of navigational factors is also determined by navigational tasks performed on the route segments, their methods of execution, airborne navigation equipment, level of aircrew navigation proficiency, and supporting activities.

On the other hand we know that flight operations areas can differ greatly in a navigational respect. For this reason it is advisable to determine the navigational environment without reference to air component, type of aircraft, and type of flight; to detail the navigational environment attending a specific flight by a specific aircrew or subunit to carry out a combat mission in a specific area, on an aircraft of a specific type and at an altitude and airspeed specified in advance, with specified restrictions, and with support provided in specific combat conditions.

The navigational environment cannot be estimated as something which exists only objectively, independent of the combat mission, the sequence, manner and organization of its execution, and the nature of combat actions. In order to determine the navigational environment with maximum completeness, it is necessary not only to proceed from the situation in the flight operations area but also to consider navigation tasks and problems which will occur during the flight, supporting activities, sequence, procedure and organization of performance of the combat mission, the operational-tactical environment and situation and nature of combat actions, and level of navigating proficiency of the personnel involved. The environment and situation must be skillfully and intelligently predicted.

We feel that in this respect it is necessary to refine and detail the definition of the term "navigatsionnaya obstanovka" [navigational environment; navigational conditions or situation] and to improve the estimation and evaluation process.

Symptoms, Hazards of Hypoxia Described

91441332k Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 32-33

[Article, published under the heading "Flight Safety: Specialist Advice," by Col Med Serv V. Stepanov, candidate of medical sciences; Lt Col Med Serv A. Fedoruk, candidate of medical sciences; Lt Col M. Dvornikov, candidate of medical sciences; Lt Col V. Shcherbinskiy: "Hypoxia—A Treacherous Foe"]

[Text] During flights at high altitude the "altitude" in the pressurized flight decks and cabins of modern aircraft can run from 1,000 to 8,000 meters. Proper utilization of oxygen breathing equipment (KDA) and protective gear totally eliminates the adverse effects of high-altitude flight factors on crewmembers. In spite of this, however, instances of dangerously near-mishap air incidents have been recorded which involve the development of oxygen starvation (hypoxia) during flight. Analysis indicates that these incidents have been caused by failure of flight and engineer-technician personnel to observe proper procedures in using oxygen breathing equipment and high-altitude gear. This occurs in particular during flights in which time is of the essence, when a pilot has limited time to check aircraft systems.

The following violations of proper flight procedure are the most typical: taking off with a limited supply of oxygen; taking off with aircraft oxygen supply system valve closed; failure fully to close the ORK [expansion unknown] coupling; failure to connect the pressurized helmet or demand oxygen mask breathing oxygen hose to the regulator; selecting the wrong mask and poor oxygen mask fit; poor mask-to-face seal; removing the oxygen mask or opening the pressurized helmet visor at high altitude; failure of the protective gear to match the mission.

The probability of hypoxia increases considerably in these cases when cockpit or cabin depressurization occurs.

There are two additional procedural errors which at first glance do not directly lead to hypoxia, but in case of depressurization and the forming of overpressure in the breathing system, they can result in the mask being stripped from the face, with the most serious consequences. These procedural errors involve failure to connect the upper or lower attachment points of the KM-32

mask to the helmet with built-in headset and microphone and failure to connect the oxygen mask breathing cavity to the microphone fit-tightness compensator or flight helmet.

What are the symptoms of hypoxia, and can a pilot recognize the problem and cope with it?

Depending on specific circumstances, hypoxia can develop comparatively slowly—as one climbs to higher altitude—or suddenly—when oxygen is shut off at altitude. In the former case the pilot has a better chance of recognizing a dangerous situation and, consequently, of correcting it. In the latter instance the pilot has practically no time for situation recognition and response.

A progressive decline in a pilot's work efficiency is noted at "altitudes" above 6,000 meters. This decline commences approximately 2-3 minutes after reaching this altitude. There occurs diminished accuracy in performing control movements, disruption in the structure of gathering of instrument information, and slowing of decision making, particularly in complex situations.

The degree to which these changes are pronounced depends on the degree of hypoxia and the time of its effect, on the pilot's individual sensitivity to hypoxia, and on his level of proficiency.

As a rule change in a person's degree of subjective physical well-being and overall condition during hypoxia is manifested in the form of a number of various symptoms. The most typical include sleepiness, the body becoming hot, usually the entire body, the sensation of rush of blood to the head, tinnitus, dizziness, sometimes nausea and general weakness. Breathing becomes more rapid and deeper, sometimes accompanied by shortness of breath. One feels a lack of air. There is increased resistance to breathing, which can lead to removing the mask or opening the pressurized helmet visor.

Impairment of vision also occurs: objects appear to be more poorly lit and fuzzy; one's vision narrows; one's gaze is fixed on some one instrument, while all other instruments are outside of one's field of vision; vision darkens to gray or even blackens. Disruptions occur in the operation of the antagonist muscles of the arms—in most instances with predominance of flexor activity, which affects precision of performance of control movements.

Impairment of movement coordination is aggravated by the occurrence of tremor, and this worsens the pilot's flying ability to an even greater degree. To this we should add diminished mental activity, impairment of short-term and long-term memory, diminished capability to predict flight situations, and change in emotional state (sluggishness, drowsiness, and sometimes the opposite—excitement, euphoria). All this is frequently accompanied by an inappropriate attitude toward the current situation and lack of a critical attitude toward one's condition and evaluation of one's condition.

In the case of acute hypoxia, a two-phase reaction is noted as regards indicators of physiological functions. At first development of adaptive responses occurs. These include increase in heartbeat and arterial pressure, attended by the feeling that one's head is bursting, a throbbing headache, noise and pounding in the temples, and a feeling of hotness. Other indicators include increase in pulmonary ventilation, accompanied by increased breathing resistance and a sensation of lack of air. If the pilot fails to recognize the condition of hypoxia and fails to take steps to reestablish normal oxygen supply (fails to check whether there is oxygen in the system, to adjust his oxygen mask, to close his pressurized helmet visor, fails to switch on emergency oxygen supply or fails to descend to a safe altitude—4,000 meters or lower), the second phase of response may set in: exhaustion and breakdown of the adaptive mechanisms—a sharp drop in activity by the cardiovascular and respiratory systems, and loss of consciousness. Loss of consciousness is preceded by total loss of ability to think.

One must be clearly aware of the fact that critical perception of one's state is diminished or totally lacking in a pilot who is in a state of hypoxia. For this reason crew members are inclined to ascribe unpleasant sensations which arise, especially if they are not pronounced, to the effect of other factors of flight or to excessive fatigue. This can lead to actions which aggravate the emergency situation: continuing to fly at a dangerous altitude, and failure to use the oxygen breathing equipment.

Delayed or incorrect response to air traffic controller instructions makes the situation even more hazardous. But the pilot perceives his actions as being absolutely correct, and ascribes all discrepancies to equipment malfunction or incorrect actions by the air traffic control team. He is able to recognize his condition and identify it as being caused by hypoxia only if he possesses good theoretical knowledge of hypoxia and, most important, has practical acquaintance with it, knows it, and remembers the conditions in which it can occur.

On the basis of what signs or symptoms can crew members or air traffic controller suspect hypoxia in a pilot?

First of all it is essential to consider the overall flight environment: altitude and nature of the mission being flown. Peculiarities in radio communications can serve as reliable, albeit indirect, signs of development of a state of hypoxia during flight. They are manifested in diminished activeness and purposefulness of pilot speech activity; in change in timbre of speech and voice emotional coloration which is typical of this; in utilization of nonstandard phrases and change in vocabulary of question and response; in an increase in latent speech response time to a simple request (by a factor of four or more) and increase in delay before the mike push-to-talk button is released (by a factor of 2-3); in slowing of speech tempo (by approximately a factor of 2); in

decreased radio response, and subsequently total failure to respond to calls; in the occurrence of multiple keying of the mike without actually saying anything (this occurs as a rule one to two minutes prior to losing consciousness); in keying the mike and holding down the microphone push-to-talk button (just before losing consciousness).

Studies have shown that the auditory function is maintained in these conditions practically right up to total loss of consciousness. This can and should be actively utilized by the air traffic control team to bring a pilot out of a state of hypoxia.

The ATC team can obtain useful information from analysis of radar data and other means of monitoring an aircraft (on the basis of change in course, altitude, and scheduled maneuvers).

In addition, one can establish with a high degree of probability the fact of development of a state of hypoxia during flight by analysis of flight data recorder tapes. Increase in amplitude of roll and pitch control movements, failure to observe proper time and sequence of performance of specified flight parameters, and actions opposite to those required at the given moment can serve as signs of approaching danger.

When oxygen supply is returned to normal, a person in a state just preceding loss of consciousness or during loss of consciousness recovers consciousness in 5-15 seconds, while ability to perceive and evaluate one's state and situation takes 15 to 20 seconds longer. The ability to perform purposeful aircraft control actions, however, is restored only 30-120 seconds after recovering consciousness. During this period a pilot is capable of performing only thoroughly-practiced actions pertaining to stabilizing safe flight parameters, but he is not yet clearly aware of what he has done and what remains to be done.

Often a pilot, after recovering from hypoxia, performs actions which he was performing just before losing consciousness. For example, he again proceeds to climb, which sharply aggravates the situation. This is probably connected with developing retrograde amnesia and loss of memory of events preceding loss of consciousness.

ATC controller instructions during this period should be precise, specific, and contain clear statements on what the pilot is to do in order to ensure flight safety.

A pilot's principal physiological functions are restored within three to five minutes. Full recovery of work efficiency requires from 8 to 10 minutes following normalization of oxygen supply, although the pilot subjectively feels entirely fit and efficient much sooner. Only after complete condition normalization is the pilot capable of executing a proficient approach and landing. Both the aircraft commander and air traffic controllers should take this into consideration in their decision making.

Symptoms of hypoxia can vary with different individuals at the same altitudes and with the same duration of hypoxia. This is connected with differing individual sensitivity to hypoxia.

A high physical stress load prior to flight operations, insufficient rest or sleep, poor preflight diet, consumption of alcohol just prior to flying or on the preceding day, excessive smoking, partial recovery following illness, the effect of high G forces, motion sickness, and overheating can affect tolerance to hypoxia, substantially diminishing it. One should also bear in mind that at high altitudes (7,000-8,000 meters) sudden loss of consciousness without warning is possible.

In order to prevent hypoxia, it is important that flight personnel be acquainted with and mandatorily observe during flight the requirements of regulations and instructions pertaining to operation of oxygen equipment and high-altitude gear, and that they be able to identify in themselves or other crew members initial symptoms of hypoxia and be able to take intelligent actions to correct this condition.

Peacetime Helicopter Crew Proficiency Criticized

91441332l Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) p 38

[Article, published under the heading "Problems of Training and Indoctrination," by Military Pilot 3rd Class Gds Sr Lt N. Vertiy: "Why Did the Air Assault Fail?"]

[Text] As the saying goes, the cloth rips at the thinnest spot. We received additional evidence of the validity of this saying during a recent tactical air exercise.

According to the exercise plan, helicopter crews were to fly routes with which they were unacquainted and deliver an assault force to an unfamiliar landing site. A difficult mission, but within the capability of well-trained aircrews. All they needed to know was where they would be flying. On this occasion, however, when preparing for the mission, flight personnel were unable to study with mission-plotting photomaps the area where the air assault force was to be landed. Obsolete data were used in refining mission details.

Execution followed preparation. The element leader's crew did not immediately spot and recognize the landing site. They had to fly a second pass. This destroyed the element of surprise. There was a regular merry-go-round in the air above "enemy"-controlled territory, since all the troop-lift helicopters had to go around and fly a second pass. Finally they put the assault force down and returned to base, since the simulated enemy fire caused only simulated losses.

Last year something similar occurred during performance of a combat training mission at the range. This

time the helicopter crews successfully passed the range test. But now they were unsuccessful in the assault force delivery. Many of my colleagues felt that the foul-up during the tactical air exercise was a consequence of concentrating the attention and efforts of personnel on range problems to the detriment of other types of combat training.

But I believe the main reason lies elsewhere. We were done in primarily by a predictable-pattern, routine approach to preparing for flight operations involving landing at off-airfield sites and involving low-level flight. Why do I feel that this is so?

We, for example, have become accustomed and often see nothing bad in the fact that training flights are always to the same landing site, with aircrews well familiar with the site's location, approaches, and landmarks.

Such training flights do little to increase the professional skills of veteran pilots and navigators. The combat experience of helicopter crews in Afghanistan and the practical experience of daily training suggests the need to practice more and more frequently in landing onto sites of various complexity. Question: where are these sites to be found?

In my opinion we could use as one probable variation sites specified as emergency landing sites. Most crews are familiar with them only on the map. For this reason flights to these landing sites would be useful even for the purpose of familiarization, for in an emergency situation any obstacle with which a crew is unfamiliar can lead to making the situation more difficult.

I should also like to mention low-level flying. This is unquestionably one of the most difficult parts of flight training. It would seem that the entire process of training flight personnel in low-level flying should maximally correspond to the level of complexity and importance of the end objectives. But what is actually happening? Low-level practice flying as a rule is done along a "well-trodden" route and across thoroughly familiar ground.

And it goes on like this year after year. Everybody—I am talking about trained pilots and commanders—is aware of the deficiencies of the established practice of low-level flight training. In addition, since most of the crews have experienced the harsh school of combat proficiency in the Republic of Afghanistan, the men know that in actual combat everything is much more complex and that demands on the flying skills and moral-psychological conditioning of flight personnel are immeasurably greater. They are not keeping quiet about this; they talk about it at meetings, at training classes, and in conversations with one another. And it would seem that there are no rabid opponents of restructuring of the training process, and yet everything continues in the old way.

I therefore feel that failures in mission performance are not mere happenstance. Even the experience and skill of the Afghan veterans have provided no guarantee to this subunit's aircrews against poor performance. And it is probably unfair to blame solely the pilots and navigators for this. For decline is inevitable if a person is not given a work load commensurate with the level of his professional training and proficiency. This is true in any field, and particularly in flying. And yet each pilot, navigator, and aircrew is tasked with continuously improving combat proficiency. How can this be accomplished?

This unquestionably requires new approaches to planning and organization of helicopter crew personnel combat training. In the opinion of Gds Majs K. Melyakov and P. Fedorov, Gds Capts D. Ivashkin and V. Komnov, and others of my colleagues, one should begin with an objective appraisal of its current state and determination of positive aspects as well as shortcomings which diminish the effectiveness of training. We feel that first of all it is necessary to get rid of predictable pattern and some possibly unjustified limitations and restrictions in flight training, as well as unnecessary situation simplification.

One realistic way to overcome this is seen in individualization of aviator personnel flight and overall combat training. This has been under discussion for quite some time. The need for an individual approach is as obvious as is the difference in skill between young pilots and navigators and their older comrades with a 1st-class rating and considerable experience in performing training and combat missions. This difference in flight training and proficiency is currently being insufficiently taken into consideration. Is it not high time to turn to individual plans and schedules for improving the job proficiency of helicopter pilots and crewmen, which ensure stable, consistent growth in the performance skills of each pilot and navigator, from one flight to the next and from one flight operations shift to the next?

Ground Testing of Energiya Launch Vehicle Described

91441332m Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 40-41

[Article, published under the heading "Space Flight Support," by Candidate of Technical Sciences V. Filin, deputy chief designer: "Energiya's Terrestrial Orbits"]

[Text] There exists a much-used phrase: "The foundation of success in the air is laid on the ground." The meaning of these words is probably most obvious to hardware developers. Indeed, who else can better appreciate that long, difficult journey from those first axial lines traced on drafting paper to the appearance "in metal" of the full-scale working Energiya space shuttle booster system (URKTS) and the Buran orbital vehicle?

This country has allocated considerable funds to this program, in view of its importance for accomplishing future scientific, economic, and other tasks, including the tasks of development of international cooperation in space. And all those who have taken part in designing,

developing, building, and testing the Energiya-Buran space shuttle system have been aware of their responsibility for the reliability and safety of program execution and have understood that the slightest degree of chance can lead to catastrophic consequences from the standpoint both of material loss and loss of morale. Therefore from the very outset the project was conducted according to the principle of ensuring maximum reliability, safety and, in the final analysis, high operational durability of components, systems, and the space shuttle system as a whole.

Persons involved in motor vehicle operation are well aware, for example, of the fact that the greater an engine's power reserve, the greater its actual service life, and the more confident a driver feels on the road when passing and performing other maneuvers. Thus greater thrust capability was designed into the launch vehicle, which provides capability to continue the mission even if one engine fails.

In designing airborne and spaceborne craft there is a constant effort to ensure an adequate safety factor of strength and stability at minimum cost in weight, which is particularly typical of rockets and aircraft.

Selection of reasonable safety factors is an entire science in itself. We never cease to marvel at the beauty of ancient structures and works of technology and the skill of those who designed and built them. But if they were built today, they would unquestionably look different, since modern technology cannot be based on the standards of the ancients. For rocket hardware extra structural weight can frequently lead even to the impossibility of performing a specific task.

Efforts to achieve minimum rocket structural weight and maximum efficiency and payload constitute the basis of all rocketry design and development, for the cost of boosting a kilogram of payload into orbit runs hundreds of rubles, and calculation of performance characteristics in relation to mass is performed to an accuracy down to grams with a piece of hardware weighing hundreds and thousands of tons.

Machinery and equipment will eventually break down. This is why one fairly frequently applies the principle of redundancy. This principle was applied extensively and across the board in designing the Energiya launch vehicle. The system was designed in such a manner that the mission could continue with the failure of any one component, and that safety was ensured with two failures. Other principles ensuring the rocket's capability to do the job were also applied: the adoption of special diagnostics monitoring the operation of powered-up components; use of standardized components and modular units which have first been tested, proven, and refined on other equipment; automation of launch preparation processes and processes of readying for operation in flight, etc.

Principles can remain mere declarations if they are not incorporated into the documentation, into the manufacture and, what is particularly important, if the effectiveness of their implementation is not confirmed by ground testing.

When one talks about development of a piece of equipment, this means primarily not only development of documentation and manufacture. The longest and most laborious process is the process of experimental investigation, testing, refining and bringing items up to their specified performance characteristics, and the cost of this process can amount to as much as 95 percent of total costs of testing the first regular production unit.

There are various ways and means of confirming the correctness of adopted principles during the process of design and at subsequent stages in order to achieve a rocket's specified performance characteristics. These include theoretical calculation methods, development and refining of regular production items in the process of flight testing and, finally, maximum refinement of individual components, devices, units, experimental installations, and the rocket as a whole in the course of ground testing, prior to commencement of flight tests. Everything depends on the correlation between the cost of these activities and the potential material loss as well as political damage and loss of morale which can occur with unsatisfactory performance in operational service.

Unquestionably neither the theoretical calculation method, which results in large errors when applied to complex new hardware, nor building dozens of regular production units to confirm performance characteristics in flight-testing heavy-lift launch vehicles were appropriate. The developers of the space shuttle system understood this well and, in view of the considerable cost of the launch vehicle and the adverse consequences of equipment malfunctions in flight, from the very first stages of development they worked aggressively on solving the problem of obtaining maximum confirmation of excellent performance capability by all components and systems prior to the first full-scale launches.

Comprehensive ground development and refinement of adopted design solutions helped achieve this. Not one component—from an integrated circuit to a structural assembly weighing hundreds of kilograms—was approved for operational use without passing thorough preliminary ground tests. Painstaking refinement was conducted on models, mock-ups, experimental installations, as well as on experimental (static-test) full-size equipment. More than 350 large-scale units were built, on which structural components, mechanisms, units, instrumentation, and processes were subjected to various tests. Development included structural components, compressed-gas and hydraulic systems, control system, propulsion units, large-unit separation systems, fire and explosion prevention devices, telemetry systems, antenna and transmission-line equipment, onboard computer software, as well as advanced processes and operations for equipment manufacture,

assembly, and preparation, including the manufacture and installation over large areas of insulation and tank heat shielding, new kinds of welding, etc.

Processes of fuel fluctuations in the tanks and their effect on launch vehicle stability during flight were studied, as well as thermophysical and adhesion properties of heat insulation, heat and mass exchange in conditions of cryogenic temperatures, distribution of possible hydrogen and oxygen leaks in the compartments and bays and methods of desensitizing them, load-carrying capabilities and strengthening of structural components at cryogenic temperatures, dynamic processes during stage separation, launch vehicle aerodynamic characteristics, and gas dynamics of launch. Selection and optimization of requisite quantity of pressurization gas in the fuel tanks, means and methods of neutralizing and localizing sources of fire and explosion-hazard situations, conditions of thermostatic control of components and rocket structural design, operating modes of diagnostic systems and emergency protection systems were conducted.

A problem, properties and processes cannot be investigated if one has only the items to be tested. Also needed are tools and instruments which enable one to study them in detail. In development of the Energiya launch vehicle these tools included more than 100 specially-designed or upgraded test beds, including such unique installations as the test bed built at the Baykonur space launch center, from which the first experimental Energiya booster was launched on 15 May 1987.

Practically every test bed comprises an entire enterprise with massive structures, custom-built testing and diagnostic equipment, and the most advanced computer hardware for processing experiment results.

These facilities have acquired versatile capabilities and can be effectively utilized, in particular, in the interests of development of nontraditional, ecologically clean power generation, new types of air and motor transport, and effective systems for controlling complex industrial processes.

The volume and intensity of ground experimental activities during development of the Energiya space shuttle launch vehicle were quite substantial, and exceeded previous such activities by a full order of magnitude. More than 6,500 tests were conducted just at the large-scale installations. The total number of tests would exceed 100,000 if one considers all tests performed on individual components, units, engines, control and measurement systems, and modules. For example, the fittings and other hardware used in operation of pressurized-gas and hydraulic hydrogen and oxygen feed systems totaled more than 50 item designations and were subjected to almost 30,000 tests. Development and refinement were performed on thousands of fluid lines, each of which was tested time and again for strength, seal, heat resistance, and other factors.

High effectiveness of ground-testing, product development and refinement was also achieved by testing assemblies, components, and systems in harsher conditions than anticipated operational conditions, with testing of warrantied operational safety margin beyond the limits of the tolerance envelope for determining parameters, operating time, and in various adverse (abnormal or emergency) situations. For example, the first- and second-stage engines were also tested with foreign-matter particles deliberately added to the fuel. The engines were tested to confirm an operating life of at least three times the projected requirements, and in equipment in which pressures reach 600 atmospheres, temperature in hot sections exceeds 3000 degrees Celsius, and with pumps and turbines turning at about 10,000 rpm.

It is difficult within the confines of a single article to encompass the entire extent and all features of experimental development and refinement of the Energiya launch vehicle system, particularly since one can understand how difficult it was for the developers of this unique piece of hardware at the initial development stage, until they gained a detailed understanding of all the problems and tasks of developing its dozens and hundreds of component parts and had devised a comprehensive program of experimental development and refinement of the launch vehicle system.

Enormous ground has been covered in developing this unique launch vehicle. Everything that could be done in ground tests was accomplished to a substantial degree prior to commencement of flight testing, and now they could proceed with a full-scale launch. And such a launch took place. The first experimental flight, on 15 May 1987, ended the testing phase in launching unmanned vehicles. All that remained was to final-refine certain items and confirm stability of launch vehicle performance characteristics.

The first launch was followed by additional tests involving 19 experimental installations, one of the main objectives of which was to debug the software for combined operation of the Energiya launch vehicle and Buran orbital vehicle. We should mention the particular importance of this area of experimental refinement, since the level of automation and equipping of Energiya and Buran with computers greatly exceeds that on all prior-developed equipment.

Onboard computer systems provide highly-precise control of all complex systems in preparing for launch and during flight, as well as continuous monitoring of all components and systems, informing ground systems and services of the status of onboard systems, and generating control instructions for numerous variations of change in the environment, with various malfunctions and emergency situations, and ensure the continued operation and safety of this unique launch vehicle. The high degree of artificial intelligence of the control system is determined to a considerable degree by powerful software involving conditions of thousands of variations of

possible implementations of control modes for the launch vehicle's numerous components.

In connection with this, in the process of development of the Energiya launch vehicle and the Buran orbital vehicle, such an area of experimental development as debugging and ensuring high dependability of software assumed great independent significance. Algorithms, individual programs and software packages were thoroughly tested on combined test beds, on experimental full-scale test-bed units, and during direct launch preparations.

Millions of cycles of running and debugging programs in various situations, including improbable situations, were performed. Software operational reliability was demonstrated not only during successful launches but also in the emergency situation which occurred in October 1988, when the control system triggered automatic launch countdown abort when the azimuthal orientation system card had not been withdrawn. Similar control system actions would have occurred in other emergency situations, which were repeatedly run during ground testing.

Finally it was 15 November 1988! What tension! Had all "ifs" been taken care of? Had everything been considered and verified? And it was only the statement "Flight nominal" which was repeatedly made by the commentator over the public-address system which gradually relaxed the tension. And the words "We have orbital vehicle separation!" evoked applause and joyous ovation on the part of all persons involved in development of the Energiya booster, who were following the launch and who were finally seeing successful embodiment of many years of enormous development effort and painstaking refinement of this unique launch vehicle.

Projects to Study Magnetosphere, Ionosphere

91441332n Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 42-43

[Article, published under the heading "Future of the Space Program," by Yu. Zaytsev, department head, USSR Academy of Science Institute for Space Research: "In an Ocean of Plasma"; first part of two-part article]

[Text] The fourth state of matter is called plasma. It occurs in nature much more frequently than those states of matter with which we have been familiar since childhood—solid, liquid, and gaseous. All the stars, including our sun, the interstellar and interplanetary medium, and the upper layers of the planetary atmospheres (ionosphere)—in short, approximately 99 percent of matter in the Galaxy—consists of plasma. It comprises a mixture of electrically-charged particles, in which the quantity of negative "components" is precisely balanced by positive components.

The electrical ocean which surrounds our planet is more mobile than a gaseous ocean. During magnetic storms the concentration of particles in this ocean may increase by hundreds of times, which affects the propagation of radio waves. For this reason the earth's electric mantle is an extremely important object of investigation. But this is not the only point. The earth's entire biosphere, its animal and plant world feels the influence of processes taking place in the solar and cosmic plasma. It is for this reason that reports on magnetic storms are radio-broadcast along with the weather forecast.

Today plasma is of equal concern to the designers of future thermonuclear power generating stations, astrophysicists, biologists, and radio engineers, as well as many other representatives of various fields of science and technology. With the advance of space research they have had placed at their disposal an enormous natural laboratory, a laboratory which in terrestrial conditions would be beyond one's wildest dreams. This laboratory lacks "walls," which frequently distort experiments. It has become possible to study plasma in its natural state.

At the beginning of the space age the so-called solar wind was discovered—intensive plasma fluxes traveling radially out from the sun. They accelerate as they move further from their source, which ultimately results in a supersonic stream of plasma in earth orbit. Encountering our planet's magnetic field, the solar wind localizes it in a limited cometiform area—the magnetosphere. On the side facing the sun its boundary is located approximately 70,000 kilometers from the earth's center, while in the opposite direction it extends out many millions of kilometers, forming the earth's magnetic tail.

Space vehicle launches, including the pioneers of the space age—the Soviet Lunas and Elektrons, as well as today's Prognoz and Unmanned Universal Orbital Station (AUOS) satellites, have made it possible to study to a considerable degree the configuration of the magnetosphere and the parameters of the plasma which fills it. A general picture of the energetics of the magnetosphere and certain processes responsible for its activity was obtained. It is manifested, for example, in the form of powerful magnetic storms and various forms of electromagnetic emissions in various regions of the spectrum—polar auroras, magnetospheric bursts of radio-frequency emissions, etc.

It was ascertained that magnetic field intensity in the tail of the magnetosphere is very low due to its immense size. At the same time enormous energy, in the order of 10^{23} erg, the source of which is the solar wind, is amassed in the tail. Moving in the interplanetary magnetic field, it generates electric fields and currents in the magnetosphere, similar to the way this takes place in a magnetohydrodynamic generator. But energy in the earth's magnetosphere cannot increase infinitely. From time to time inverse transformation occurs, into energy of fast plasma fluxes and high-energy particles. The electrical fields and currents generated come into contact with the earth's conductive ionosphere, causing magnetic storms. The

drop in electrical field potential between the magnetospheric tail and the earth's ionosphere leads to acceleration of electrons, intrusion of which into the earth's upper atmosphere creates polar auroras, varied both in form and color.

Thus the solar wind, the earth's magnetosphere and ionosphere constitute a closely interlinked and highly time-variable electrodynamic system. For this reason investigation of the cause-and-effect relations between phenomena which take place in it requires simultaneous probing of various critical regions in each of its elements, using several space vehicles operating according to a common program. Measurements should also be performed simultaneously by ground stations.

We should note that attempts to identify the physical processes responsible for key phenomena in the interplanetary and magnetospheric plasma had been undertaken time and again, but as a rule by a single space vehicle. This did not provide the capability to separate spatial changes in the measured parameters of the plasma and fields from their changes with time. The only exception was three U.S.-European satellites, ISEE 1, 2, and 3, but investigations using these satellites were directed primarily toward study of the structure and motions of the shock wave adjacent to the Earth's magnetosphere and its boundary—the magnetopause.

Scientists hope to obtain extensive scientific results in the area of physics of plasma phenomena occurring in near-earth space in the course of Project Interbol, which is scheduled for 1990-1991. This project calls for launching two Prognoz satellites. One of them will operate in the tail of the magnetosphere, at a distance of 150-200 thousand kilometers from earth, where solar-wind energy is transformed into magnetic-field energy and where this energy is accumulated, resulting in magnetospheric storms. The other satellite will pass through that region of the magnetosphere located at an altitude in the order of 5-15 thousand kilometers above the polar aurora zone.

In order to determine which of the parameters recorded by the satellites' onboard instrumentation are temporal and which are spatial, each Prognoz satellite will be accompanied by a small subsatellite, containing a course correction motor to change its position relative to its companion.

Investigation of the plasma and magnetosphere structure of the far regions of the magnetosphere tail (at distances of more than 1 million kilometers from earth) is to be conducted simultaneously with measurements by the Prognoz satellites and their subsatellites. These investigations will be performed by a group of plasma instruments carried aboard the Relikt 2 astrophysical satellite, which is to be boosted at that same time into a halo orbit close to the sun-earth libration point. Such synchronous measurements will help us better understand the dynamics of the earth's magnetosphere as an integral plasma-magnetic system and will give us an understanding of the occurrence of acceleration and subsequent evolution of plasma structures which form in the tail during periods of transformation of magnetic energy.

In addition to Soviet scientists, participation in Project Interbol will involve colleagues from Czechoslovakia (the subsatellites are being built in Czechoslovakia), Bulgaria, Poland, the GDR, Cuba, Austria, Canada, Finland, France, as well as a number of member organizations of the European Space Agency. USSR Academy of Sciences corresponding member A. Galeyev, director of the USSR Academy of Sciences Institute for Space Research, is serving as project scientific director. Scientists from the United States, the European Space Agency, and Japan also plan to conduct investigations of the processes in the cosmic plasma, with the aid of several space vehicles operating on a common program.

Project Interbol will make it possible substantially to broaden the range of obtained information. In particular, it is known that active processes in the tail of the magnetosphere operate for a comparatively short time—in the order of one hour. At the same time the orbital period of a high-apogee satellite which goes beyond the bow wave will be several tens of hours.

It is not possible to record information along the entire orbital path, since computer data storage capacity is limited. As a result the principal event may not be recorded. For this reason Project Interbol calls for using an intensified telemetry interrogation mode based on indicators of the target phenomena. These indicators will be determined by onboard computer on the basis of information received from key instruments for study of a given phenomenon. When several such indicators are received, the command is given to step up interrogation of a broader group of instruments. In addition, simultaneous measurements from the subsatellites will make it possible not only comparatively easily to separate spatial and temporal variations in the target parameters but will also provide the capability to exclude the influence of errors caused by the space vehicle structure.

Project Interbol will make it possible independently to solve a number of fundamental problems of physics of magnetospheric activity and magnetosphere-ionosphere linkages. At the same time using measurement data obtained in various regions of the global system, especially monitoring of states of the solar wind and far tail of the magnetosphere, would make it possible more reliably to determine the cause-and-effect relations of the processes occurring there. For this reason international exchange of obtained data and joint interpretation of measurement results are very important.

On the whole one can state that the principal task of investigation of plasma in near-earth space in the period 1990-2000 will be organization of multiple-probe measurements with high spatial and temporal resolution.

The fact is that while in the case of laboratory installations one must consider the effect of the finite dimensions of the probes and the presence of walls, the system as it exists in space is on the contrary too large for cause-and-effect relations of the processes developing within the system to be able to be understood if measurements are taken only at a small number of points, which of course is always limited to the number of available space vehicles.

Deployment of a sufficiently dense satellite system, in addition to providing answers to the questions of plasma physics, would at the same time be an important element in studying the influence of solar activity on the earth's atmosphere, climate, and biosphere.

Accomplishment of these tasks will be the principal goal of experimental research using a system of small space laboratories (MKL) fitted with solar sails—the Regata [Regatta] project.

The MKL was developed by scientists and specialist personnel at the USSR Academy of Sciences Institute for Space Research. Its design meets stringent demands pertaining to magnetic and chemical purity and precise orientation and is distinguished by relative simplicity and the capability to carry a sufficiently large payload. The laboratory is designed to operate for an extended period of time.

The Regata project is to be conducted in 1993-1995 in coordination with the European Space Agency's Cluster project, the purpose of which is to investigate the fine structure of plasma processes in near-earth space.

In recent years space plasma investigations have been devoting increasing attention to active or controlled experiments, in the course of which phenomena of interest to scientists are artificially stimulated in near-earth space. Controlled experiments are divided into two main groups on the basis of nature of effect. The first group consists of experiments of the "test particle" type, which do not alter the qualitative state of the medium. Experiments involving injection of low-power electron and ion beams, as well as experiments involving release of lithium vapors, also fall within this group.

Under the effect of solar ultraviolet radiation, initially neutral lithium vapors are transformed within several hours into an ionized cloud. The lithium ions serve as a small admixture to the helium protons and ions which comprise the main content of the solar wind plasma. By adjusting satellite-borne detectors which record corpuscular particles to detection of lithium ions, one can obtain an overall cross section of the near-earth solar wind zone and the earth's magnetosphere, and one can determine the major mechanisms of penetration by particles into the magnetosphere, their acceleration and capture by the radiation belts. Such experiments constitute planetary analogues to the proven method of tinting a liquid or gas to determine the nature of currents and turbulence.

The second group of active investigations includes experiments with powerful electron and ion beams capable of appreciably altering the state of the plasma by artificial generation of electromagnetic waves within the plasma.

Extremely low-frequency radio waves can also be used as an active diagnostic means. The magnetosphere is practically an ideal waveguide for such radio waves, due to which they can travel repeatedly between magnetically coupled points. Traveling an enormous distance of several earth's radii and reflecting at a magnetically coupled point, these waves bring to the receiving point a great deal of interesting information on the parameters of the ionosphere and magnetosphere plasma.

At the first stage ground-based radio transmitters were used to excite radio waves of this band in the magnetosphere. A large part of their energy is lost, however, due to scattering in the atmosphere and the lower ionosphere. This can be avoided if the transmitter is placed aboard a satellite. Calculations indicate that an orbital transmitter of several kilowatts makes it possible to obtain a stronger electromagnetic wave in the magnetosphere than a ground-based one-megawatt transmitter. Consequently one can also more effectively trigger a broad range of phenomena which will be the magnetosphere's response to a wave propagating in it. Such phenomena include, in particular, the pouring of electrons and protons out of the radiation belts, excitation of plasma oscillations, and heating of the ionospheric plasma by these oscillations. **(To be concluded)**

Planet Orbital Photogrammetry Detailed

914413320 Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 44-45

[Article by G. Glabay: "Space Photogrammetry"]

[Text] **On the Road of Knowledge**

From time immemorial, when gazing at the stars and the moon, man would ask himself: just what is that and how can one get there? But it was not until January 1959 that the Soviet space vehicle Luna 1, reaching escape velocity, overcame the earth's gravity and opened up a path to the planets. Nine months after the launch of the first Soviet lunar probe, the Luna 3 unmanned probe, having executed suitable maneuvers, transmitted back to the earth the first picture of the far side of the moon.

The passage of time is swift. Today, 30 years later, flights to Venus and Mars, travel across the moon's surface by lunar rovers, and the encounter with Comet Halley seem routine.... Today scientists are thinking about a manned mission to Mars. Someday man unquestionably will set foot on other planets as well, but for the present remote sensing has become the principal method of studying the planets. This method makes it possible to obtain images

of the surface of planets and their moons in relation to the astrophysical peculiarities of the bodies of interest.

Information on the surface of a celestial body, following suitable processing, serves as the input data for mapmaking, for it is difficult to study the astronomical objects of the solar system without detailed maps of their surface. The images obtained from unmanned interplanetary probes have made it possible to observe and study planet surface details measuring tens and hundreds of meters, and virtually right down to millimeter size after sending landing modules onto the planetary surface.

Space photogrammetry as a method of investigating celestial bodies arose at the juncture of astrometry and photogrammetry. Space photogrammetry enables us to perform measurements and conversions of space imagery, to interpret images, and to determine the dimensions, shapes, mutual relationships and spatial attitude of the imaged objects.

We should note that photogrammetry—measurements based on photographic images—has long and beneficially served man. Originating in the middle of the last century, it came into extensive use in geodesy, astronomy, archeology, forensic medicine, engineering and military affairs, as well as in measuring the movement of clouds, the motion of waves, and in examining the trajectories of rapidly-moving objects.

Space imagery is also being successfully utilized to determine the physical, geological, and other characteristics of the planets and their moons, as well as for tying in coordinates based on the results of remote measurements obtained by various scientific instrumentation. Such a broad range of application of space imagery is also establishing new tasks for photogrammetry. The content of the methods and modes of imagery processing is also changing significantly.

Beyond the Clouds

Photographic, TV, phototelevision [TV transmission of processed photographic images], and radar equipment can be used in imaging the surfaces of celestial bodies. Each of these techniques has its own information storage devices and imaging principles.

Photographic systems, for example, use photographic film. Photographic film is the most preferable medium for photogrammetry. The process of delivering photographic film from distances measuring in the millions of kilometers, however, is fairly long and involves considerable technical difficulties. For this reason it was used only in photographing the moon. The Zond 5 through 8 unmanned probes delivered exposed black-and-white and color film to earth between 1968 and 1970.

Television systems use a radio link to transmit images. Information can be transmitted by downlink both directly and from magnetic-media mass storage devices. The first TV imaging from the surface of the moon was performed in February 1966 by Luna 9.

Phototelevision systems perform onboard exposure and processing of film and transmission of TV signal by the scanning-beam method, using various schemes of line and frame scanning. On the ground the received information can be recorded on thermochemical paper, videotape, or from kinescope screen onto photographic film. A phototelevision system was first used on Luna 4.

The radar method is considered to be the most effective technique in investigating Venus. In 1983 Venera 15 and Venera 16 used radar to transmit panoramic coverage of that planet's northern hemisphere. The system included a side-scanning radar and radar altimeter. An onboard radio transmitter was used to radiate and receive signals reflected from the planet's surface. A radar image would form on the basis of the power of signals reflected from the surface and comprised a sum of corresponding brightness elements. And, finally, charge-coupled devices (CCD) were subsequently used as a detector. The Fobos probe, for example, employed such devices in its videospectrometric system.

Mapping systems are generally subdivided on the basis of structural geometry into frame, scanner, panoramic, and Doppler-ranging. One of the tasks of space photogrammetry is to establish linkage between them.

Now let us imagine that an unmanned interplanetary probe is traveling somewhere out in space, millions of kilometers from the earth, and is imaging a planet or its moon. But how does one determine or compute the projection of a surface-imaging beam? The imaging camera's coordinate system serves as input information.

The camera's angular position at a given moment in time is determined in an inertial (possessing only rectilinear and uniform motion) system referenced to the planet's center of mass. Such a system has practically the same angular orientation in space as the basic coordinate system with its origin at the sun's center of mass. But since space vehicle observation data must be reduced to systems rigidly bound to the target celestial body, one must also deal with rotating coordinate systems—planetocentric and planetographic. The former are used in plotting controls and tying parameters of gravitational field and space vehicle navigation to them, while the latter are used in plotting maps.

In addition, a surface close to the actual surface is used to determine the third coordinate—altitude of a point. Such a mathematical model of a planet or moon is called a reference surface. Some are considered a sphere, while others, such as Phobos or Deimos, for example, are considered triaxial ellipsoids.

A timeline tie-in of obtained images is performed immediately following orbital imaging. Depending on the equipment used, it boils down to recording the moments at which the camera shutters are triggered or establishing the actual time of beginning and end of a session involving scanner and radar systems. In order to improve the accuracy of tie-in, such as in the TV panoramic imagery obtained from the Venera 9 probe,

electrical pulse marks generated by the unit's timing device would be imprinted at 2-minute intervals.

Coordinate tie-in is performed simultaneously with timeline tie-in. The former is needed for current planning and scheduling of probe vehicle instrumentation operation and plotting coordinate grids on space imagery, as well as for preparing working plans for processing materials.

As a rule coordinate grids are plotted on transparent plastic. And if geometric transformation of images is not to be performed, the images together with the coordinate grids essentially constitute photomaps in any given cartographic projection.

The TV panoramic imagery obtained by the Mars 4, Mars 5, Luna 22, and Venera 9 unmanned probes, for example, became a cartographic product of this type. A geomorphological study of the Moon and Mars also subsequently became possible. These materials were also used in analyzing the dimensions and orientation of spiral, cellular and other types of cloud structures in the Venusian atmosphere.

Plotting Control Networks

Creation of topographic and thematic maps and performance of scientific, engineering, and technical tasks pertaining to studying celestial bodies is impossible without coordinate control networks on their surface. But how is it possible, without working directly on a planet, to lay out networks similar to the geodetic networks we have on earth? And, without these geodetic points, how is it possible to accomplish subsequent final bridging, which is so essential in order to final-process orbital cartographic imagery?

Space photogrammetry deals with this general problem. To accomplish the task it utilizes mathematics, images, and comparators—devices for measuring the coordinates on images. These latter also help plot a photogrammetric network of a given scale which is not referenced in space. It must now be converted to a planetocentric system.

The following analogy is useful here. A person resting in his bunk in his cabin, in a ship at sea, does not know his position relative to the shore. He can learn his position with certain additional linkages. That is the case here as well. Seven external parameters, such as the angular elements of the external orientation of the images, determined from photographs of the star-filled sky, ballistic data of imaging camera motion, radar profiling data on the planetary surface, as well as others, help accomplish this.

Initially control networks were plotted on the Moon, Mars, Mercury, moons of Jupiter (Io, Europa, Ganymede, Callisto) and on the moons of Saturn (Mimas, Enceladus, Tethys, Dione, Rhea, and Iapetus). Subsequently, just as on earth, practical realities compelled additional bridging. It is being performed with conventional methods of phototriangulation without considering data on the orbit of the probe vehicle and is being performed in the same coordinate system as the control networks. Now one can proceed to process information into a form which people can understand.

Countenances of Celestial Bodies

Orbital imagery as a rule contains considerable geometric distortions caused by the tilt of the imaging camera lens and the curvature of the imaged surface. Traditional methods and devices used to process this information are poorly suited to the task. They are acceptable, however, with some breaks in image integrity and loss of accuracy. Photomosaic-derived photomaps of areas of Mars were obtained in this manner, from imagery provided by the Mars 4 and Mars 5 probes, as well as the first map of the Moon, from images taken by Luna 3.

Today the analytical method, using image input-output systems and computers, is the most promising method of transforming orbital imagery into given cartographic projections. In this case an orbital image, containing a discrete array of elements reflecting its brightness characteristics, is converted into codes, and correction of densities is performed in order to improve the image's optical properties and to eliminate defects and interference contained in the original material. Analytical conversion boils down to transforming, following a specified principle or pattern, the original image matrix to a converted image matrix. The latter is converted, using computer and output device, into an electrical signal and then into a light flux which is recorded on film.

The requisite set of programs and algorithms has recently been developed for analytical conversion of orbital imaging data into desired cartographic projections and for creating photomosaic-derived photomaps. And this, in particular, has made it possible to convert TV and radar panoramic images of the surface of the Moon and Venus, obtained by the Luna 22, Venera 15, and Venera 16 unmanned probes.

Our knowledge of celestial bodies will be incomplete if the elevation characteristics of their surface remain unknown. Radar and laser remote sensing by unmanned probe vehicles is helping reveal these secrets.

A combination of the method of planet profiling and stereophotogrammetric image processing method is presently considered to be the most promising direction in this field. Stereophotogrammetric processing makes it possible to consider various imagery errors. Even using a highly-accurate stereo comparator and computer, however, does not provide capability to determine elevations with a high degree of accuracy. This is due to the poor image resolution, adverse conditions for obtaining a three-dimensional location fix, different plotting geometry, and in certain cases differing raster structure as well. This problem still awaits solution. Certain difficulties also arise in determining the color features of a planetary surface.

Elevation detail is currently available only for maps of the Moon, Mars, Venus, and Phobos. We should note that on topographic maps elevation information is usually indicated by horizontal lines or shading to show elevation contrast. For example, the contour interval on the 1:60,000 scale map produced on the basis of Phobos images (Mariner 9 probe) is 100 meters.

Study of celestial bodies is not limited solely to orbital imaging by unmanned probes but is also conducted with planetary lander and rover vehicles. We should note that such activities were performed by Luna 9, 13, 20, Lunokhod 1, 2, and Venera 9, 10, 13, and 14.

Such imaging is essential in order to produce large-scale topographic maps, to study the microstructures of a planet's surface, and to tie in various types of measurements. Development of methods of processing these materials also fall within the tasks of space photogrammetry.

In concluding our discussion of space photogrammetry, we should note that imagery obtained from unmanned interplanetary probes has not only increased our knowledge of celestial bodies but has also opened up extensive possibilities for discovering prior unknown moons such as Metis, Adrastea, Thebe, Atlas, Telesto, and Calypso. In addition, in the course of unmanned probe missions it became possible to examine asteroids and comets. We might recall the photographing of Comet Halley from close range, performed by the Vega 1 and Vega 2 probes.

Thus by using spaceborne devices, specialists are creating reduced information models on the world around us, revealing its uniqueness and unusualness.

Stealth Technology Aircraft Described

91441332p Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) pp 46-47

[Article, published under the heading "The Pentagon's Strategic Arsenal," by A. Mashin: "'Invisible' Craft Above the Planet"; based on materials published in the foreign press]

[Text] **Recently the United States slightly raised the curtain of secrecy over projects involving the development and use of extremely low-signature or low-observables aircraft or, as they are also called, Stealth aircraft. In the opinion of Pentagon strategists, research in the area of Stealth technology will make it possible to solve a number of problems, and first and foremost to disrupt strategic stability between the USSR and the United States and to draw the Soviet Union into another costly round in the arms race.**

Intensive efforts to develop such aircraft have been in progress in the United States since the latter half of the 1970's. In the intervening years a large number of materials dealing with this topic have been published abroad, but due to the classified nature of these projects, information has been of a hypothetical or evaluative nature and has dealt primarily with the physical appearance of Stealth aircraft, structural and other materials used in building them. This was due primarily to the fact that it had been announced that it was possible to reduce the intensity of radar signals reflected from aircraft of a certain shape by reflecting them away from the illuminating radar site, as well as by absorbing part of the energy of these signals with special materials. Requirements pertaining to reducing aircraft signature in the infrared band also gave reason to expect the appearance of nontraditional aircraft shapes and designs.

* * *

At a press conference held on 10 November 1988 D. Howard, an official spokesman for the U.S. Department of Defense, announced that the U.S. Air Force was flying the Stealth fighter, previously known by the designation F-19, and presented a photograph. It was announced that the reduced radar- and infrared-signature fighter was officially designated F-117A.

Its full-scale development began in December 1978, and its maiden flight took place in June 1981. The process of development and operation of the F-117A was not without in-flight incidents, including two fatal crashes. The fighter entered service in October 1983. Fifty-two aircraft had been delivered by mid-November 1988. According to reports in the foreign press, seven additional aircraft are under construction and will be delivered to the U.S. Air Force in 1990.

The F-117A fighters are assigned to the 4450th Tactical Training Group at Nellis Air Force Base, Nevada, and are based at the test operations field on the Tonopah EW Range. Until recently their flights were conducted under a veil of secrecy, for the most part at night. C-5 military transport aircraft delivered fighters, equipment, and spares from the Lockheed plant to the Tonopah range.

Just what is this fighter, about which there have been so many different rumors? It is of a monoplane design, with a rather unusually-shaped fuselage, which U.S. specialists call "pyramidal." The fuselage surface is formed of a large number of flat-angled facets which are somewhat deflected to reflect and scatter radar signals. Foreign experts claim that using such flat-angled facets will weaken reflected radar signals and "reduce" the fighter's effective radar-reflecting surface.

Composite materials based on Kevlar fibers are used in the airframe structure. The material Fiberloy was used in fabricating some of the wing skin panels, some of the stringers and ribs. Skin in the area of the engines and wing leading edge, as well as the forward section of the fuselage are made of carbon-reinforced plastic.

The laminated construction of the skin in the engine area is unusual. The filler is a matrix consisting of pyramids

with a 12.7 x 12.7 mm square base, narrowing inwardly. The aircraft is coated with a radar-absorbing paint containing ferrite particles. Individual airframe metal structural components which can be radar-illuminated are also coated with this paint.

The aircraft is powered by two nonafterburning engines, each with a thrust of 4.9 t. The air intakes are located behind the cockpit and are of unusually massive construction. The exhaust nozzles are positioned atop the fuselage, along the wingroot, just forward of the tail. Exhaust gases emerge above the upper surface of the fuselage, which serves as a thermal shield. This, along with cooling of the exhaust gases by engine bypass ducting air, decreases the probability of aircraft detection in the infrared.

The Stealth fighter's canopy design is also unusual. It consists of five panes—one windshield pane and four side panes.

The F-117A is a subsonic single-seat fighter. Its primary mission is to penetrate hostile airspace undetected and to attack high-priority targets. For this reason it would be more correct to classify it as a strike aircraft.

Although some of the F-117A's specifications and performance characteristics which have been published at various times are more of the nature of an estimate, they nevertheless provide an idea of its specifications and performance. Its length is 15-18 m, maximum wingspan—12.2 m, 5.0 m with folded swing sections; height 4.0 m, maximum takeoff weight—15,000 kg. Service ceiling to 20,000 m. Combat radius approximately 1,500 km. Armament is carried in two internal bays and can consist of air-to-air, air-to-surface, and antiradiation missiles.

The B-2 bomber is another member of this family. The B-2 development project is one of the most highly-classified projects, and although news of the Stealth aircraft first leaked out in the latter half of the 1970's, no reliable information on it was published. There was no dearth of suppositions, however, about its performance and appearance. And not until 22 November 1988, during a public unveiling at the airfield at the Northrop plant, was it finally confirmed that this aircraft in fact exists. According to UPI, the B-2 bomber is designed to fly nuclear strikes against the Soviet Union, primarily against well-fortified or hardened underground command centers and mobile missiles in conditions of opposition by modern air defense assets. U.S. Department of Defense experts claim that it will probably remain in service with the U.S. Air Force for 30 years.

The U.S. Department of Defense plans to purchase a total of 132 of these bombers. According to the estimates of Western experts, one such bomber can carry up to 24 nuclear weapons. This means that these bombers will be capable of carrying approximately 2,000 of the 4,845 nuclear warheads planned to be carried by U.S. Strategic Air Command aircraft. The aircraft's armament, consisting of gravity bombs and air-launched guided missiles, is contained only in special bays inside the fuselage, on revolving-type rotating launchers. The B-2 was initially designed to operate at medium and high altitudes, but subsequently its design was optimized for low-level operations as well as for operating over water.

This product of the U.S. military-industrial complex can be described as follows. The aircraft is shaped by 12 straight lines in planform. The wing leading-edge sweep angle is 35 degrees. The wingtips form an acute angle with the leading edge, and the trailing edge of the outboard wing sections runs almost parallel to the leading edge. The trailing edge of the inboard wing section describes a tailward salient angle, and the longitudinal axis is flanked close inboard by two noseward cuts or notches positioned under the engine exhaust nozzles. From the standpoint of structural aerodynamics, this design retains the advantages of a "flying wing" as regards spanwise distribution of loadings. Wing weight and lift are distributed in similar fashion, due to which bending moments will be reduced. Also contributing to this is the abrupt narrowing of the wingtips, which in turn will lead to "bell-shaped" spanwise distribution of lift. Western experts are hoping with this to solve the problem of lateral instability, which is aggravated by the fact that the B-2 aircraft has no vertical tail. The wing sweep angle ensures the requisite force moments on deflection of elevators, flaps, and elevons.

The requirement of low-level flight capability led to considerable reworking of the original B-2 design. Externally its shape changed little, but the structure became stronger and more rigid.

The aircraft's wing is of interest. It is of torsion-box construction. The forward and rear wing spars, which take the bulk of applied loads and stresses, serve simultaneously as torsion box walls. They extend into the central part of the fuselage. The wing center section spars are arranged in the same manner.

Composite materials were extensively employed in this aircraft's construction, with preference given to radar-absorbing honeycomb structural components rather than radar-absorbing coatings, which are used, although only to a small degree, on the nose and wingtips.

The flight deck for the two-man crew (an optional third crew member can also be accommodated), as well as instrument and weapons bays, are located in the central section of the fuselage. Crew access is via the nose gear well. The aircraft is dual-control, with central controls. The instrument panel consists largely of electronic displays (electronic flight information system, engine instrument and caution advisory system [EFIS, EICAS]), providing information on flight parameters and status of aircraft systems and weapons. The aircraft is equipped with a fly-by-wire control system and an improved in-flight stability augmentation system.

The aircraft is powered by four nonafterburning turbofan engines of 8,620 kg thrust each, located to the sides of the flight deck in two engine nacelles with recurved air intakes, the inner surfaces of the rear portion of which are also of complex shape. The downward-curved intake ducts shield the engine's forward blades from radar illumination. There are also small air intakes, which are probably used for additional cooling of exhaust gases.

The Western press has reported on several occasions that this design is not without shortcomings and that it may be changed or modified.

Here are some specifications and performance characteristics. Length—21.03 m; wingspan—52.4 m; height—5.18 m. Maximum takeoff weight—180 t; combat payload—appr. 18,000 kg. Combat radius (depending on mission profile and altitude—to 9 km; speed—subsonic; possible ceiling—15,250 m.

The B-2 bomber is equipped with the Milstar satellite communications system. Western experts believe that burst transmission or pseudorandom frequency-changing transmission will be employed.

The B-2 acquisition program, due to its high cost and questionable effectiveness, has caused much criticism to be leveled at the U.S. Department of Defense. According to the figures of the Congressional Office of Technology Assessment, the total cost of the B-2 program will run about 60 billion dollars. The General Accounting Office considers that even this enormous sum may be exceeded, and states a program cost of 68.8 billion dollars. But even these expenditures do not guarantee that the B-2 will fully meet requirements. In the opinion of M. Brower, a military affairs expert with the Union of Concerned Scientist, the B-2 will not possess sufficiently accurate means of identifying small mobile targets, which will make it virtually useless against such targets as ICBMs. In spite of this fact, however, the Pentagon is making every effort to promote projects connected with the development of a new generation of aircraft such as the B-2 and F-117A. The Transatlantic strategists would like very much to shift the balance of military-strategic parity in their own favor by acquiring Stealth aircraft, tasked with becoming a component part of the U.S. nuclear "triad."

Articles Not Translated From AVIATSIYA I KOSMONAVTIKA No 6, June 1989

91441332q Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89) p 48

Publication Data

91441332r Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 6, Jun 89 (signed to press 5 May 89)

[Text] English title: AVIATION AND COSMONAUTICS

Russian title: AVIATSIYA I KOSMONAVTIKA

Editor: O. A. Nazarov

Publishing house: Voyenizdat

Place of publication: Moscow

Date of publication: June 1989

Signed to press: 5 May 1989

10

Foreign Broadcast Information Service (FBIS) and Joint Publications Research Service (JPRS) publications contain political, economic, military, and sociological news, commentary, and other information, as well as scientific and technical data and reports. All information has been obtained from foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. Items generally are processed from the first or best available source; it should not be inferred that they have been disseminated only in the medium, in the language, or to the area indicated. Items from foreign language sources are translated; those from English-language sources are transcribed, with personal and place names rendered in accordance with FBIS transliteration style.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by FBIS/JPRS. Processing indicators such as [Text] or [Excerpts] in the first line of each item indicate how the information was processed from the original. Unfamiliar names rendered phonetically are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear from the original source but have been supplied as appropriate to the context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by the source. Passages in boldface or italics are as published.

SUBSCRIPTION/PROCUREMENT INFORMATION

The FBIS DAILY REPORT contains current news and information and is published Monday through Friday in eight volumes: China, East Europe, Soviet Union, East Asia, Near East & South Asia, Sub-Saharan Africa, Latin America, and West Europe. Supplements to the DAILY REPORTs may also be available periodically and will be distributed to regular DAILY REPORT subscribers. JPRS publications, which include approximately 50 regional, worldwide, and topical reports, generally contain less time-sensitive information and are published periodically.

Current DAILY REPORTs and JPRS publications are listed in *Government Reports Announcements* issued semimonthly by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 and the *Monthly Catalog of U.S. Government Publications* issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

The public may subscribe to either hardcover or microfiche versions of the DAILY REPORTs and JPRS publications through NTIS at the above address or by calling (703) 487-4630. Subscription rates will be provided by NTIS upon request. Subscriptions are available outside the United States from NTIS or appointed foreign dealers. New subscribers should expect a 30-day delay in receipt of the first issue.

U.S. Government offices may obtain subscriptions to the DAILY REPORTs or JPRS publications (hardcover or microfiche) at no charge through their sponsoring organizations. For additional information or assistance, call FBIS, (202) 338-6735,or write to P.O. Box 2604, Washington, D.C. 20013. Department of Defense consumers are required to submit requests through appropriate command validation channels to DIA, RTS-2C, Washington, D.C. 20301. (Telephone: (202) 373-3771, Autovon: 243-3771.)

Back issues or single copies of the DAILY REPORTs and JPRS publications are not available. Both the DAILY REPORTs and the JPRS publications are on file for public reference at the Library of Congress and at many Federal Depository Libraries. Reference copies may also be seen at many public and university libraries throughout the United States.